Department of Primary Industries

5-Year Review of the 2009 Joint Management Agreements for the NSW Shark Meshing (Bather Protection) Program

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5-Year Review of the 2009 Joint Management Agreements for the NSW Shark Meshing (Bather Protection) Program

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More Information

http://www.dpi.nsw.gov.au/fisheries/info/sharksmart/meshing

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Consulting the Community

You are invited to make submissions on this Review, the draft 2016 Joint Management Agreement and draft 2016 Management Plan for the NSW Shark Meshing (Bather Protection) Program, which are on public exhibition until close of business **31 March 2016**.

The documents are available online at http://www.dpi.nsw.gov.au/fisheries/info/sharksmart/meshing.

The documents can also be viewed during normal business hours at the following locations:

- Department of Primary Industries Head Office, 161 Kite Street, Orange
- Department of Primary Industries, Level 47, MLC Centre, Martin Place, Sydney
- Department of Primary Industries coastal fisheries offices
- Office of Environment and Heritage Head Office, Level 14, 59-61 Goulburn Street, Sydney
- Office of Environment and Heritage Newcastle Office, 117 Bull Street, Newcastle West
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Lodging your submission

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Nelson Bay NSW 2315

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Submissions must be received by close of business 31 March 2016

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1 Executive Summary

Since the 2009-10 meshing season, the NSW Government's Shark Meshing (Bather Protection) Program (SMP) has operated in accordance with Joint Management Agreements (JMAs) and an associated Management Plan authorised by the *Fisheries Management Act 1994* and the *Threatened Species Conservation Act 1995*. The Parties to the Agreements are the Minister for Primary Industries, the Director General of Primary Industries, and the Chief Executive of the Office of Environment and Heritage.

Clause 8 of the 2009 JMAs make provision for review reports to be prepared when trigger points to monitor the objectives of the JMA are tripped. Four of those trigger points have been tripped, however the review reports were not prepared by the Department of Primary Industries as required by the JMAs.

Clause 9 of the JMAs requires that the JMAs be reviewed every five years. This report is the first of those 5-year reviews, and also includes the four outstanding trigger point review reports. This report recommends numerous amendments to the 2009 JMAs, and if the Government endorses those amendments, a new JMA will need to be prepared for the SMP.

This report was prepared by the JMA Review Team, which was established by the Parties to the JMAs and comprised of representatives from the Department of Primary Industries and the Office of Environment and Heritage. The objective was to identify clauses or aspects of the 2009 JMAs and the Management Plan that may be limiting or restricting the capacity of the JMAs to meet the overarching aim of the SMP, which is 'to reduce the threat of shark interactions within the area of operation of the program whilst minimising impacts on non-target species'.

A shark bite of a surfer at Redhead Beach in 2011-12 caused serious injuries and tripped the objective of 'reducing the risk to humans from shark attacks at beaches of the SMP'. The review report concluded that a White Shark between 2.5 and 2.7m in length was probably responsible for the bite, but did not recommend any changes to the JMA or Management Plan.

Slip and fall incidents of a contractor and an observer in 2012-13 tripped the objective of 'OHS incidents'. The review reports identified the need for some operational changes for contractors with respect to net cleaning and maintenance, and recommended amending the definitions of minor and major WHS incidents in the Management Plan.

The entanglement of a Humpback Whale in 2012-13, and entanglement and fatality of another in 2013-14 tripped the objective of 'entanglement of threatened species'. The review report concluded that the fatality may have been avoided if the Large Whale Disentanglement Team had been able to get to the animal in a more timely fashion. The review acknowledged that procedures and communications have improved as a result of the 2013/14 whale fatality, but recommended that there be an increase in the number of whale disentanglement and/or removal teams along the NSW coast, not just in the SMP area, and an increased number and capacity of rapid response vessels and teams.

The SMP annual performance report for 2013/14 was not submitted to the relevant parties by 31 July 2014 and tripped the objective of 'transparent monitoring and reporting'. The review report concluded that under-resourcing of the SMP caused the delay. The review did not recommend any changes to the JMA, however it identified the need for the Parties to the Agreements to reconsider funding arrangements.

The 5-year review identified numerous editorial amendments (e.g. dates, department names, and definitions) and recommends some substantial amendments of the 2009 JMAs. Those amendments, if endorsed by the Parties to the Agreements, will require a Draft 2015 JMA (and Management Plan) to be submitted to the Scientific Committee and the Fisheries Scientific Committee for review, and for the public to be given an opportunity to make submissions on the draft agreement.

Notable amongst the recommendations are:

- amalgamating the two existing JMAs in accordance with the *Fisheries Management Act 1994* and the *Threatened Species Conservation Act 1995* into a single JMA in accordance with s.221W(3) of the *Fisheries Management Act 1994*;
- removing the requirement to review the JMA in response to the listing of threatened species, and instead adding it as a new trigger point for the threatened species objective;
- splitting the trigger point for non-target species into three new trigger points to better reflect the different listing status of non-target species (e.g. endangered, vulnerable, un-listed);

- establishing a 6 month timeframe from publication of the Annual Performance Report for the completion of review reports;
- removing Shortfin Mako Sharks and Broadnose Sevengill Sharks from the list of target sharks;
- retaining the existing spatial (51 beaches between Newcastle and Wollongong) and temporal (1 September - 30 April) structure of the SMP;
- preparing a new Strategic Research and Monitoring Program and associated funding model under the Management Plan;
- establishing a 7th operational region, to be known as Central Coast North, by reallocating the beaches in the Hunter and Central Coast regions; and
- implementing vessel monitoring systems on Contractors' vessels.

Consulting the Community

You are invited to make written submissions on this 5-year review report, the Draft 2016 Joint Management Agreement and draft 2016 Management Plan for the NSW Shark Meshing (Bather Protection) Program, which are on public exhibition until **31 March 2016**.

The documents can be inspected during ordinary office hours from **1 February 2016** at the following locations:

- NSW DPI HEAD OFFICE, 161 Kite Street, Orange
- NSW DPI Fisheries, coastal offices
- OEH HEAD OFFICE, Level 14, 59-61 Goulburn Street, Sydney
- OEH NEWCASTLE, 117 Bull Street, Newcastle West
- OEH CENTRAL COAST, 207 Albany Street North, Gosford
- OEH ILLAWARRA, 84 Crown Street, Wollongong

Copies of the draft Agreement are also available online at OEH (www.environment.nsw.gov.au) and DPI Fisheries (www.dpi.nsw.gov.au/fisheries/info/sharks/meshing).

Would you like to comment?

Submissions on the 5-year review report, the Draft 2015 Joint Management Agreement and Draft 2015 Management Plan can be made by:

- email to: jma.2016review@dpi.nsw.gov.au or
- writing to: JMA Review Submissions
NSW DPI
Locked Bag 1
Nelson Bay NSW 2315

Submissions will be dealt with in accordance with the *NSW Privacy and Personal Information Protection Act 1998*.

1 Introduction

1.1 Background

The NSW Government's Shark Meshing (Bather Protection) Program (SMP) is administered by the Department of Primary Industries (DPI), a division of the Department of Industry, Skills and Regional Development (formerly the Department of Trade and Investment, Regional Infrastructure and Services - DTIRIS). The SMP is a public safety measure first implemented at 18 Sydney beaches in October 1937 in response to approximately 69 shark interactions in all NSW waters between 1900 and October 1937, and 36 of those interactions were fatal (Global Shark Attack File, download 31 July 2015). Since 1937, there has only been one fatal interaction on a meshed beach, and that was at Merewether Beach, Newcastle, in 1951. Over the same period there 12 fatalities at unmeshed beaches in NSW.

The SMP was expanded in 1949 to include beaches at Newcastle and Wollongong, and in 1987 it was further expanded to 11 beaches of the Central Coast. The SMP currently uses specially designed bottom-set meshing nets off 51 beaches between Newcastle and Wollongong, and runs from 1 September to 30 April each year. According to Surf Life Saving NSW approximately 5.8 million people visited beaches of the SMP region during 2013/14.

The SMP was subject to a review and environmental assessment in 2009, and since then has been authorised by and managed in accordance with two Joint Management Agreements (JMA) and a Management Plan. Joint Management Agreements are agreements provided for in both the *Fisheries Management Act 1994* (FM Act) and the *Threatened Species Conservation Act 1995* (TSC Act) to manage, control, regulate or restrict an action that is jeopardising the survival of a threatened species, population or ecological community. The JMAs include independent third-party annual review of performance reports by the NSW Scientific Committee (SC - established under the TSC Act) and the Fisheries Scientific Committee (FSC - established under the FM Act), and were publicly exhibited for comment before they were finalised.

Some of the key changes to the SMP that were implemented through the JMAs include:

- independent third-party annual review by the SC and FSC;
- increased the number of regions from 5 to 6;
- reduced net checking time from 96 to 72 hours;
- additional whale alarms and dolphin pingers;
- monthly catch reports to the FSC and SC;
- publicly available Annual Performance Reports;
- objectives, performance indicators and trigger points;
- 5-yearly review reports.

The Parties to the 2009 JMA in accordance with the FM Act are the Minister for Primary Industries and the Director-General of the Department of Industry and Investment (now the Department of Industry, Skills and Regional Development).

The Parties to the 2009 JMA in accordance with the TSC Act are the Director-General of the Department of Environment, Climate Change and Water (now known as the Office of Environment and Heritage - OEH) and the Director-General of the Department of Industry and Investment. Annual Performance Reports are prepared by DPI and reviewed by the two scientific committees, and the JMAs, Management Plan and associated reports are available at: www.dpi.nsw.gov.au/fisheries/info/sharksmart/meshing.

1.2 Purpose

This report presents the processes and outcomes of departmental reviews of the 2009 JMAs in accordance with clauses 8 and 9 of the JMAs, and Parts 7 and 8 of the Management Plan.

Clause 8.4 of the JMAs requires that review reports must be prepared at the end of a meshing season in the event that a trigger point has been tripped, and/or if timeframes under the Management Plan were not met. Trigger point review reports investigate and identify the cause of the problems and identify what, if any, remedial action is recommended to return the performance indicators to an acceptable range.

This report includes four trigger point review reports in relation to the following objectives:

- 'Reduce the risk to humans from shark attack at beaches subject to the SMP' was not met in 2011-12 following a shark bite and serious injury of a surfer at Redhead Beach;
- 'Minimise occupational health and safety risks to Contractors and agency personnel...' was not met in 2012-13 following separate slip and fall incidents of an Observer and a Contractor.
- 'Minimise the impact on non-target species and to ensure that the SMP does not jeopardise their survival...' was not met in 2013-14 following the entanglement (and subsequent death) of a Humpback Whale after two were also caught (and released alive) in 2012-13.
- 'Transparent monitoring and reporting' was not met in 2013-14 as the annual performance report was not submitted to the parties to the JMAs and the scientific committees by 31 July 2014.

Clause 9 of the JMAs requires that the Agreements are to be reviewed by the Parties to the Agreement five years from the date of commencement, or following the listing of a new species, population or ecological community under the FM Act or TSC Act that may be directly and detrimentally affected by Shark Meshing.

Scalloped Hammerhead Sharks and Great Hammerhead Sharks were listed as threatened species in the FM Act in 2012. The potential implications of the JMAs on those two species were reviewed in the 2011-12 Annual Performance Report and are not part of this Review, other than to be recognised for inclusion on the list of threatened species in the JMA and Management Plan.

This is the first of the 5-year reviews in accordance with clause 9 and is a review of the 2009 JMAs, and includes the trigger point review reports outlined above. This 5-year Review does not repeat nor is it meant in any way to replicate the 2009 comprehensive review and environmental assessment of the SMP (see Green et al. 2009). This Review is limited in its scope to the 2009 JMAs as written, although it is acknowledged that some of the operational arrangements reviewed in 2009 were subsequently incorporated in the JMAs and therefore are likely to be part of this Review. Other aspects, such as reviewing bather protection strategies in other areas, assessing trends in unprovoked shark interactions, and describing the biology and life history of affected species will only be briefly considered in this Review where they are directly relevant to the content of the 2009 JMAs.

1.3 Process

The JMAs and Management Plan outline the process for trigger point review reports, but not for the nature or process of these 5-year review reports. In the absence of a clearly defined process but seeking to be consistent with clause 48 of the Management Plan, the Parties to the Agreements established a JMA Review Team comprised of representatives from DPI and OEH. The single task for the team was to identify clauses or aspects of the 2009 JMAs and the Management Plan that may be limiting or restricting the capacity of the JMAs to meet the overarching aim of the SMP, which is 'to reduce the threat of shark interactions within the area of operation of the program whilst minimising impacts on non-target species'.

This identification process comprised four elements:

- Editorial: a 'line-by-line' review of the documents to address typographical and structural issues, such as departmental name changes and legislative amendments;
- Submissions: the scientific committees have reviewed the five Annual Performance Reports since the 2009/10 season. Their submissions were reviewed to determine the degree to which they could be addressed by amending the JMAs, Management Plan or related reporting processes;
- Operational: meetings of the Review Team to discuss operational aspects of the SMP that individually and on a yearly review basis were not deemed significant and may or may not have been included in Annual Performance Reports, but that over five years amounted to an issue/s that warranted a change in the JMA and/or Management Plan;
- Contractual: DPI staff met with the six Contractors at the 2014/15 Contractor Training Workshop on 13 August 2014, and also held a separate meeting to discuss operational/contractual arrangements in the JMA and Management Plan.

The FM Act, the TSC Act and Clause 10 of the JMAs require that a joint management agreement can only be amended by a further joint management agreement, so any changes recommended in this Review and endorsed by Government will necessitate new JMAs and a new Management Plan. As previously

mentioned, draft JMAs must be submitted to the scientific committees for review and be subject to a period of public comment (which can be simultaneous) as described in s.284 of the FM Act and s.124 of the TSC Act. To be consistent with the transparency and reporting objective of the JMA, this 5-year Review will be placed on public exhibition for a period of 30 days as a reference document for the JMAs.

In addition to the legislative consultative processes, DPI have consulted with some key stakeholder groups, including environmental non-government organisations, the scientific committees, and the Sydney Coastal Councils Group. Stakeholder meetings were held in mid-late 2014 and were focussed on providing an update about implementation, effectiveness and issues with the 2009 JMAs; to advise them of the 5-year review; and advise them that it and any new JMAs and Management Plan would be available for public comment.

2 Trigger Point Review Reports

2.1 Shark Bite and Serious Injury of a Surfer at Redhead Beach, Newcastle, 2012

2.1.1 Incident Description

At about 4:45PM on 18 January 2012, the casualty was surfing off Redhead Beach, one of the 51 beaches protected by the NSW Shark Meshing (Bather Protection) Program, when he got severely bitten on the right buttocks and posterior thigh by a large shark. There were approximately 12 other surfers within 20m of the casualty at the time of the interaction. There had been some baitfish seen in the region, but no indication that there may be a shark in the vicinity.

The casualty was thrown off his board and dragged beneath the surface. When the shark let go, he managed to get back onto his board and catch a wave to shore. There he collapsed on the sand where lifesavers applied oxygen and stemmed the bleeding while waiting for paramedics to arrive. The casualty was rushed by ambulance to John Hunter Hospital where he underwent extensive surgery over several days to repair the damage to his right buttocks and thigh.

2.1.2 Site Description

The interaction occurred approximately 40m south of the Redhead headland. The casualty was bitten approximately 40m from shore in a channel inshore of the shark net (Figure 1). The channel was about 4m deep. The shark net at Redhead Beach is set in approximately 12m water depth, and 450m offshore of the interaction site. It was in place on the day of the interaction and there is no evidence that it was not correctly positioned and maintained. There was only one capture of a shark in bather protection nets for the entire Hunter Region during the month of January 2012 - a 0.6m male Smooth Hammerhead shark caught at Newcastle on 09/01/2012. This is despite the fact that White Sharks are known to commonly occur in this area.

Aerial Surveys were flown by NSW DPI contracted aircraft on the day of the interaction at Redhead. The surveys were two transects over this beach - at 11:31am northbound and 12:56 pm southbound. Although hammerhead sharks were seen off Redhead Beach on both transects, no other shark species were seen at this beach or at any other beach that day throughout either flight between Wollongong and Newcastle.

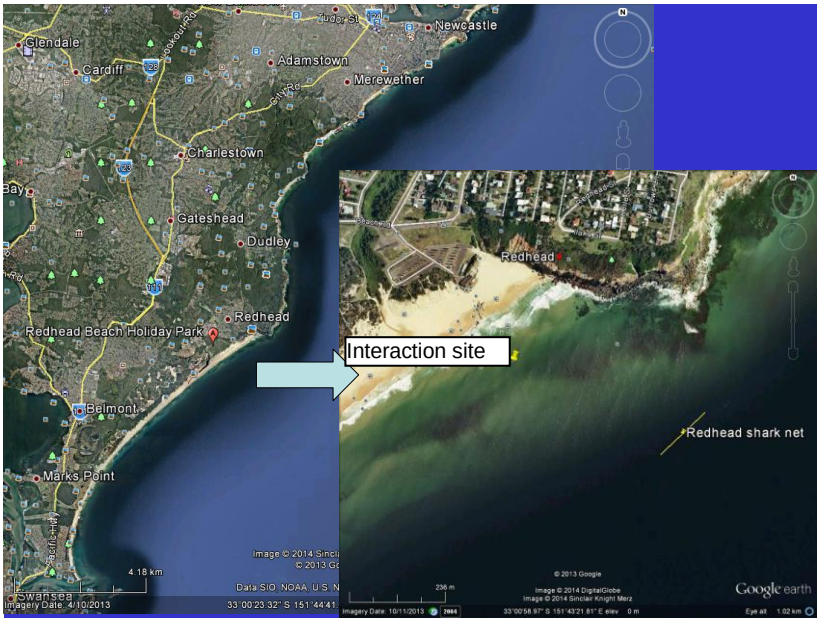

Figure 1: Redhead Beach, NSW, showing the approximate position of the shark interaction on 18 January 2012 relative to the location of the SMP net.

2.1.3 Forensic Analysis of the Bite

Due to the nature of the bite on the casualty, and the lack of photographs of his injuries including a scale reference for interdental distances (IDD) between tooth marks, only the lower jaw imprint on the lower deck of the surfboard could be used to indicate the species and size of the shark involved (Figure 2). Although all three of the potentially dangerous sharks (i.e. Bull, Tiger and White) possess 12 teeth on

each side of their lower jaw, the spacing between the teeth indicate that a White Shark (*Carcharodon carcharias*) was most likely involved. Additionally, several of the tooth imprints in the surfboard show a triangular tooth shape (Figure 2) that does not match the lower jaw dentition pattern of either a tiger or bull shark, but does match a White Shark lower jaw tooth shape.

The imprints on the lower deck of the surfboard indicate there were two bites. The first, believed to be the initial 'hit' and exhibiting a pressure indentation immediately anterior to the jaw imprint, measures approximately 235 mm in width. This imprint exhibits tooth marks for 10 teeth in the left lower jaw, suggesting almost maximal extension of the jaw over the surfboard at the initial strike (Figure 2). The arrows in Figure 2 indicate the tooth impressions for left lower teeth 1 to 10 (LL1 – LL10). The pressure imprint caused by the initial strike force is highlighted in the red oval. An example of the triangular shape of the tooth imprint is indicated in the triangle, while a second bite mark is shown by the dotted blue line.

The second bite, with concomitant removal of a section of surfboard, is less 'clear' and was not used in the forensic analysis. The evidence of two sets of bite marks corroborates the casualty's description of the interaction. The jaw width corresponds to that of a shark of at least 2590mm in total length, as calculated via regression of jaw width against total length for 18 White Sharks ranging from 1245mm to 5632mm in length (Wildman, 2011; $R^2 = 0.4279$). Further, interdental spacing for the lower left jaw shows the shark to be larger than 2270 mm, but smaller than 2718mm total length, again based on measurements from those same 18 White Shark jaws (Wildman, 2011).

It is therefore likely that the shark was between 2.5 and 2.7 metres in length.

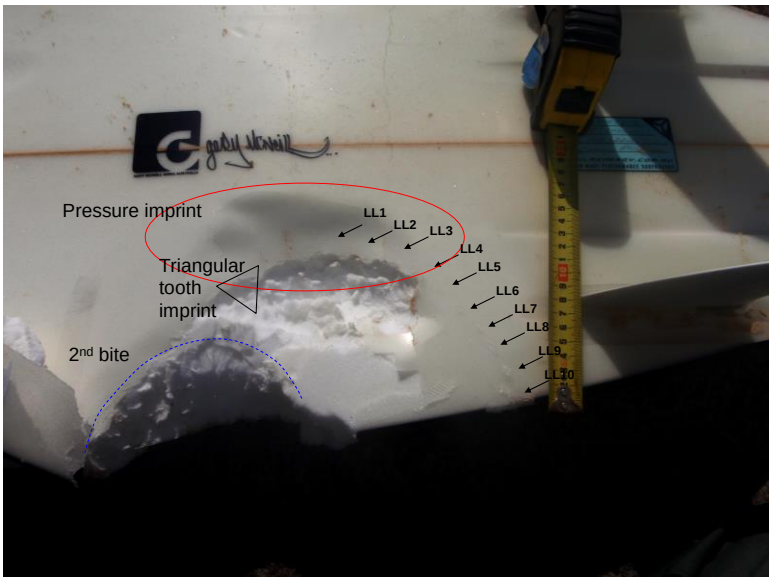

Figure 2: Lower deck (underside) of the casualty's surfboard showing the bite imprints.

2.1.4 Review of Shark Net Efficacy

The meshing nets of the SMP are 150m long by 6m deep, set parallel to the coast in approximately 10-12m water depth and approximately 500m off the beach (Green et al., 2009). All nets have been set close to the seafloor since 1972 (Reid and Krogh, 1992) in an attempt to reduce captures of air-breathing marine fauna. In accordance with the JMA, nets are checked every 72 hours (or earlier) by the relevant Contractor for each of the six regions (Reid et al., 2011).

It is unknown exactly how shark nets provide effective protection against shark bite (Dudley, 1997). In KwaZulu-Natal, South Africa, 35% of sharks captured in their beach netting program were caught on the shoreward side of the net (Cliff and Dudley 1992), suggesting the 'barrier effect' of nets may be limited, although no data exist for Australia. The nets of the SMP are only 150m in length, are set off life-guard patrolled beaches often within stretches of much longer coastline, and cover only approximately half the water column; further suggesting that the barrier effect is likely to be negligible. Sharks can swim into the waters shoreward of the net from either north of south of the installation, as well as via the 4-6m of water over the top of the net.

However, an analysis of the shark interaction rates pre-netting and post-netting for the shark control programs in KwaZulu-Natal, Queensland and NSW indicates that there has been a similar success in

reducing frequency of shark interactions (Dudley, 1997). In NSW, the shark interaction rate (number of interactions per year) fell from 0.35 to 0.04 (88%) off Newcastle following introduction of nets, while off Sydney there was a 90% reduction (0.46 to 0.04 interactions per year) (Dudley, 1997). It was recognised before meshing began “that only a complete enclosure could ever prevent all attacks...” (Shark Menace Advisory Committee, 1935), and all three shark control programs have experienced occasional unprovoked shark bite incidents at protected beaches (Dudley, 1997).

In the NSW SMP, there have been approximately 33 interactions at meshed beaches, and have resulted in 1 fatality (in 1951), 23 injuries (2 serious), and 9 bites on surf skis or surfboards that resulted in no injuries. Nineteen of those interactions have occurred since 2000, none of which were fatal. By comparison, there have been approximately 71 interactions at unmeshed beaches (approximately 710 beaches and some 900km) of NSW since 2000: 27 on the North Coast; 26 on the Mid-North Coast; six in the Hunter; one on the Central Coast; four in Sydney; two in the Illawarra; and five on the South Coast. Those interactions were comprised of five fatalities, 43 injuries and 23 without injury.

The recent shark bite and serious injury of the surfer at Redhead is one of only two that have occurred at a meshed beach of the SMP. The other serious injury at a meshed beach occurred off Bondi on 12 February 2009. A 2.5m White Shark was implicated in that incident (NSW DPI, unpublished data), and resulted in the loss of the surfer’s left hand. The single fatality and two serious injuries caused by shark interactions at meshed beaches of the SMP suggest that it has substantially reduced the number of severe shark interactions, despite the continual growth in the number of beach users.

Although Redhead Beach is considered to be outside of the recognised nursery area in NSW of the Australian east coast population of White Sharks (Bruce and Bradford, 2012; Figure 3), the region between Swansea and Redhead appears to often support reasonable numbers of White Sharks in nearshore waters (NSW DPI, unpublished aerial survey data; Newcastle Herald, 23 Jan 2012). Relatively high numbers of White Sharks are known to use the area, yet there have only been three interactions at Redhead Beach, and the SMP nets at Redhead have only caught two White Sharks since 1999/00, suggesting that the majority of sharks are transiting through the area and/or avoiding the nearshore waters used by bathers. It is not known if this is some form of avoidance reaction to the SMP nets, or a biological preference for alternate habitats.

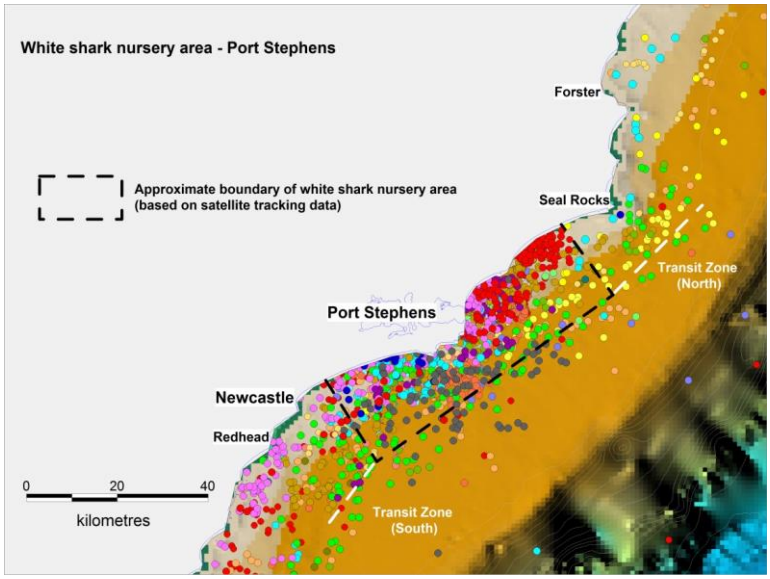

Figure 3: Approximate boundary of the White Shark nursery area off Port Stephens according to CSIRO satellite tagging data.

(Source: Reproduced with thanks to the CSIRO. Each dot represents a position/movement of at least 9 different juvenile white sharks over an undisclosed period of time)

2.1.5 Conclusions

The shark implicated in the interaction off Redhead Beach on 18 January 2012 was most likely a White Shark between 2.5m and 2.7m in length. White Sharks of this size range are utilising the nearshore waters north of Norah Head on an almost year-round basis, with some individuals exhibiting continuous residency in the Port Stephens nursery area for 5-6 months (Bruce and Bradford 2012). However, during their time

in the nursery area, juvenile White Sharks may spend as much as 18 days on temporary departures travelling at between 2-4km per hour as far away as 480km in that time (Bruce and Bradford, 2012).

White Sharks of this size range are changing their diet from one primarily based on fish to one which includes larger prey such as marine mammals (Hussey et al 2012; Dudley, 2012). As there is no maternal care and therefore no teaching of young sharks regarding prey type, it is believed that many bites of humans by White Sharks may be investigative behaviour by inexperienced sharks. This is corroborated by the large number of White Sharks in this size category which have been previously implicated in shark bites in NSW (NSW DPI, unpublished data).

Data suggest that the SMP has substantially reduced the incidence of shark interactions, by up to 90% in the Hunter and Sydney regions. However, shark nets are not infallible and will not stop all sharks from entering nearshore waters and interacting with humans. As such, DPI maintains that this shark interaction does not necessitate changes to the SMP.

2.1.6 Recommendations

This trigger point review has not identified a need for any remedial action, or changes to the JMA or Management Plan.

2.1.7 Acknowledgements

John Hunter Hospital provided substantial assistance in this case. The CSIRO Marine and Atmospheric Research kindly provided permission for the use of the image of their research showing White Shark use of the Hunter Region of the NSW coast. The casualty kindly allowed access for interviews and completion of the NSW DPI Shark Incident Information Sheet.

2.2 Slip and Fall Incident of an Observer, 2012

2.2.1 Incident Description

At approximately 7am on 21 September 2012 the Observer on board the Sydney South Contractor vessel was assisting the crew member stack fish tubs that had just been rinsed by use of a deck hose when the Observer lost his footing and fell, hitting his face on the stainless steel railing. The impact of the fall resulted in a cut to his upper lip.

2.2.2 Site Description

The incident occurred on board the “Sea Rogue”, approximately 2 nautical miles south-east of Jibbon Bombora (Figure 4). The vessel was travelling in a west-south-west direction at 8 knots. The conditions were fine with a moderate north-east breeze and 1 metre seas.

Figure 4: Location of slip and fall incident of observer on board the “Sea Rogue”.

The “Sea Rogue” is a 50 foot, 30 ton displacement timber vessel. It has a large aft deck area with a large clear working deck area. It has fixed timber benches along the vessel sides, and is driven by a 120hp Gardiner diesel engine.

2.2.3 Incident Review

The Contractor had disposed of shark carcasses outside the 3 nautical mile limit as required. The shark waste resulting from their scientific dissection was held in plastic fish tubs. After dumping the waste, the Contractor turned the vessel on a west-south-west course at 8 knots to inspect the Wattamolla Beach net.

The Contractor's crew member commenced to wash the fish tubs with the deck hose on the aft deck. A small quantity of offal was washed from the tubs and out of the scuppers into the sea. This resulted in a small amount of offal washing across the deck.

The Observer voluntarily assisted the crew member by stacking the washed fish tubs behind the timber bench on the port side. As the Observer was stacking a fourth fish tub, the vessel rolled in the swell and the Observer slipped on some remnant fish waste and fell forward onto the stainless steel hand rail on the port side gunwale, hitting his mouth on the railing.

At the time of the incident, the Observer was wearing the wet weather pants and sea boots that are part of the Personal Protective Equipment (PPE) provided by DPI to the Observers. This gear is appropriate for the role and conditions and did not contribute to the incident at all. It is not considered that different PPE could have prevented the accident.

The Contractor immediately attended to the injured Observer, applied first aid and decided to return immediately to port. The Observer was given medical assistance and had six stiches inserted in his upper lip. An 'Injury Notification' form was completed by the Contractor as is required and submitted to DPI. The incident was reviewed and deemed to be an accident and no further action was taken, nor was it necessary to report the incident to any other authority. The Observer fully recovered, suffered no permanent damage and was provided four days sick leave to recover.

Following the incident, all Contractors and Observers were reminded of their WHS obligations, basic duty of care requirements when at sea, not to let their extensive sea-going experience create a sense of complacency, and to operate at all times in accordance with the contracts, JMA and Management Plan. The Observer was reminded that his duties are that of an observational nature and do not extend to or include assisting the Contractor or his crew in the conduct of their duties.

2.2.4 Conclusions

The cause of this minor incident appears to have been failure by the Observer to maintain a firm handhold whilst undertaking actions on a moving vessel. The matter was appropriately reported and no further action was required. All Contractors and Observers were reminded of their WHS obligations, and again at the 2013-14 and 2014-15 annual Contractors and Observers Training Workshop.

2.2.5 Recommendations

According to Clause 12 of the Management Plan, this is considered to be a minor incident as it resulted in less than 5 days off work. The trigger point, however, is not particularly sensitive to the nature of the injuries and requires that review reports be prepared for a major or a minor incident. It would be more appropriate to provide further delineation between the two types of injury.

It is recommended that the trigger point in clause 12 and the definition of a minor incident in the Management Plan be amended to read:

> Trigger point: 1 major[(a)] or 2 minor[(b)] incidents
>
> (a) Major incidents are incidents that result in 5 or more days lost time;
>
> (b) Minor incidents are incidents that are reportable to NSW WorkCover or are incidents that result in between 2 and 4 days lost time.

2.3 Slip and Fall Incident of a Contractor, 2013

2.3.1 Incident and Site Description

At approximately 2.30pm on 18 February 2013, the Contractor for the Central Coast region was repairing tangled and damaged nets on a commercial wharf at The Boulevard, Woy Woy (Figure 5), when he tripped on a net cork resulting in a fall. The Contractor attended Gosford Hospital for treatment resulting in hip surgery. The Contractor did not report the incident to DPI as he was not undertaking Shark Meshing activity at the time. The DPI was informed of the incident two days after it occurred and a compliance officer immediately investigated the incident.

Figure 5: Location of slip and fall incident at Woy Woy of the Contractor for Central Coast.

2.3.2 Incident Review

The Contractor was not performing meshing activities at the time of the incident, but was repairing nets on a commercial wharf at Woy Woy. The Contractor reported that he had several tangled nets lined up on the wharf at the time of the incident. He was walking over the nets and his foot got tangled, causing him to fall onto the wharf. He reported that he fell onto his hip and allegedly suffered a broken hip. He drove himself to Gosford Hospital where he underwent medical treatment.

When the department became aware of the incident an officer interviewed the Contractor and ensured that an Injury Notification form was completed and submitted to DPI. The incident was reviewed and no formal action was taken. The Contractor did not suffer long term injuries or permanent impairment, but was unable to work for five days due to the injury.

The single causal factor for the incident seems to be a failure on behalf of the Contractor to take reasonable and sensible precautions to prevent a WHS incident and implement basic risk management at the workplace. He created the hazard by piling the nets on the narrow wharf, and then created the undesirable event (the fall) by walking over the nets. This was a matter of personal responsibility.

Following the incident, all Contractors and Observers were reminded of their WHS obligations and to operate at all times in accordance with the contracts, JMA and Management Plan. In this case the Contractor was advised not pile nets onto the wharf to maintain them and to find a safer place to carry out any required maintenance.

2.3.3 Conclusions

It was recommended as a result of the incident and contributing factors that the Contractor find a safer place to carry out maintenance of the nets and if the wharf area is required to be used, that only one net be laid out at a time on the wharf for repair/maintenance. This will alleviate excessive nets and corking on the wharf and prevent future injuries of this nature.

The incident was considered to be minor, because even though there were 5 days lost time, they did not meet the ‘major’ definition of having been compensated.

The cause of this incident appears to have been failure by the Contractor to adhere to basic obligations with respect to Workplace Health and Safety. The matter was appropriately reported and there was no need for any subsequent action beyond reminding all Contractors and Observers of their WHS obligations, and again at the 2013-14 and 2014-15 annual Contractors and Observers Training Workshop.

2.3.4 Recommendations

The review of this minor WHS incident reaffirms the recommendation in section 2.2.5 to provide for greater sensitivity in the trigger point, and in addition, to amend the definition of minor incidents in clause 12 of the Management Plan.

2.4 Humpback Whale Entanglements in Two Successive Years, 2012 and 2013

2.4.1 Incident Description

The trigger point for this objective is: *entanglements of non-target species and threatened species over two consecutive meshing seasons exceed twice the annual average catch of the preceding 10 years for those species*. The entanglement (and subsequent death) of the Humpback Whale calf at Mona Vale in October 2013 tripped the trigger point for threatened species entanglements, as it was preceded by two entanglements in the 2012-13 meshing season (Table 1).

The first incident in 2012-13 occurred in the Hunter region where the contractor reported a Humpback Whale entangled in the Dixon Park net on 16 September 2012. The National Parks and Wildlife Service (NPWS) large whale disentanglement team (LWDT) was mobilised, however no trace of the whale or net were subsequently sighted. There were also no subsequent reports further down the coast of an entangled Humpback Whale. The final fate of this whale is therefore unknown.

The second incident in 2012-13 occurred in the Sydney South region when on 6 October 2012 the contactor reported the Wanda net missing due to a whale entanglement. A whale was seen offshore, but it could not be confirmed that this was the entangled animal. As there were no subsequent reports of entangled whales, the fate of this animal is similarly unknown.

The entanglement and subsequent fatality of a Humpback Whale calf at Mona Vale beach on 22 October 2013 (i.e. during the 2013/14 shark meshing season) tripped the trigger point, although this is only the sixth known baleen whale entanglement since 1950 (Table 1). Two whales were first seen by the public at around 6am off Mona Vale. It appeared that a calf was entangled in a shark net, while an adult (presumed to be the mother) stayed nearby. Authorities were contacted by 6:50am, including the Organisation for the Rescue and Research of Cetaceans in Australia (ORRCA), NPWS and NSW DPI. An ORRCA volunteer was on site from the first report, the LWDT was notified at approximately 7:10 AM, and the ORRCA Coordinator arrived at about 8:20am.

The calf was reportedly appearing less regularly on the surface by approximately 8:30am and was last seen on the surface at approximately 8:50am. Media organisations arrived on site at approximately 9:00am, and the LWDT arrived at approximately 10am, but then struggled to get their gear and vessel onto the beach and out through the surf. The death of the whale calf was reported through media outlets at about 12:10pm.

Table 1: Reported baleen whale catches in the NSW Shark Meshing Program since 1950.

Date	Beach	Region	Whale Species	Status	Comments
06 September 1997	Collaroy	Sydney North	Humpback	Released alive	Whale cut out of netting by ORRCA
16 September 1999	Wattamolla	Sydney South	Minke	Dead	Necropsied by scientists and Taronga Zoo veterinary staff
15 November 2005	Austinmer	Illawarra	Humpback	Dead	Contractor believes whale already dead
16 September 2012	Merewether	Hunter	Humpback	Alive	Broke Free – fate unknown as not reported/seen again
06 October 2012	North Cronulla	Sydney South	Humpback	Alive	Broke Free – fate unknown as not reported/seen again
22 October 2013	Mona Vale	Sydney North	Humpback	Dead	Calf - alive at initial sighting

2.4.2 Site Description

The shark nets at all three beaches are bottom-set in between 10-12m water depth and approximately 500m offshore. Each net is 150m long by 6m deep. As they are set parallel to and relatively close to the shore, they are less likely to be encountered by migrating whales. Each net in the SMP is fitted with cetacean acoustic deterrent devices. These include three high-frequency dolphin ‘pingers’ and two low frequency whale ‘alarms’ set in an alternating arrangement 25m apart and 25m from the end of each net. The devices were reportedly operational upon checking shortly after each of the three entanglements.

2.4.3 Incident Review

From the time of first report following the 2013/14 entanglement, the LWDT was notified and activated within 20 minutes. Considering that the disentanglement teams comprise NPWS staff that had just come off fighting severe bush fires, this was considered a timely response time. However, the LWDT staff are widely spread and early morning, peak hour Sydney traffic substantially impacted on their ability to mobilise their gear and vessel and reach the site. Subsequent problems with beach access and launching of the rescue vessel through the surf compounded the time taken to reach the entangled whale calf. It was some three hours after the initial notification, by which time the calf had died.

The SMP contractor towed the whale calf to a suitable site in the Pittwater where NPWS staff and Taronga Zoo veterinary staff performed a necropsy. The results of this necropsy indicated that the female young-of-the-year Humpback Whale calf was in overall healthy condition but exhibited characteristic features of drowning (i.e. fluid in her lungs and pulmonary congestion). The calf also exhibited interesting scars from what appeared to be a previous entanglement together with an irregular scar on her abdomen which was consistent with a large shark bite.

The whale alarms were still functioning and, following comparative sound recordings by Macquarie University, exhibited only minor reduction in output consistent with their recent deployment and relatively new batteries.

2.4.4 Conclusions

The 2013-14 fatality of the Humpback Whale calf in the SMP net off Mona Vale may have been avoided if the LWDT had been able to get to it more rapidly. The KwaZulu-Natal Sharks Board in South Africa successfully released all 12 entangled large whales in 2014 and 2015, highlighting the importance of having trained, rapid response teams. The ongoing increase in Humpback Whale population size at 10.8% per annum from the current estimated 20,000 individuals will lead to a likely doubling in about seven years. Whale entanglements in fishing gear throughout their range will therefore also probably become an increasing issue and highlights the requirement to increase the number of disentanglement teams along the east coast of Australia, including in the region of the SMP.

The recent fatality of the whale calf in an SMP net led to an interagency debrief of the event, and more frequent meetings of the Northern Beaches Interagency Marine Mammal Operations Group to effectively manage marine mammal incidents that occur in the Manly, Warringah and Pittwater Local Government Areas. This group meets regularly to ensure all members are kept abreast of latest developments in dealing with entangled and stranded large whales.

An Incident Action Plan for Large Whale Disentanglement has been drawn up for more systematic and rapid response to entangled whales. The action plan will be used to mobilise the LWDT and includes representatives from NPWS, Fisheries NSW, ORRCA, SLSA and various councils in the process.

Fisheries NSW is involved with researchers from Macquarie University, Taronga Zoo and NPWS to assess the efficacy of the currently available whale alarms in deterring whales from fishing gear, and to develop alternative strategies as bycatch mitigation for large whales in various types of fishing gear.

2.4.5 Recommendations

The NSW SMP nets have entangled fewer whales than either of the Queensland or South African bather protection programs. This is undoubtedly due to removal of the SMP nets from NSW waters over the winter months when north-bound whales migrate closer to shore. It is therefore recommended that seasonal deployment of the SMP nets should be continued as a whale bycatch mitigation strategy.

As the whale populations utilising the east coast of Australia are recovering to pre-harvest stock sizes, it is inevitable that more entanglements will occur with fishing gear throughout their range, including the nets of NSW SMP. Research into the efficacy of commercially available whale alarms, such as those used in the SMP, suggests they illicit negligible responses by migrating humpback whales, however the experiments were not conducted using alarms set in a configuration similar to that used in the SMP nets. Further research is required into the efficacy of sounds to deter whales from their travelling routes. Until such research is complete and/or proven alternatives become available, it is recommended that the 3 kHz whale alarms should continue to be used in the SMP.

The fatality of the whale calf in the SMP during the 2013/14 season highlighted that a rapid and systematic response is crucial to successful disentanglement. Whilst it is acknowledged that some procedures and communications have improved as a result of the 2013/14 whale fatality, it is recommended that there be

an increase in the number of whale disentanglement and/or removal teams along the NSW coast, not just the SMP area, and an increased number and capacity of rapid response vessels and teams.

2.5 Submission of the Annual Performance Report, 2013/14

2.5.1 Incident Description

The JMAs and the Management Plan require an Annual Performance Report (APR) to be prepared and submitted to the parties to the JMAs and the two scientific committees by 31 July each year, i.e. three months after the conclusion of the meshing season. The 2013/14 APR did not fulfil those requirements as it was not submitted to the parties and the committees until 15 October, triggering a review report for the 'transparent monitoring and reporting' objective.

2.5.2 Incident Review

2013/14 saw an unprecedented amount of public interest in the SMP following on from the Western Australian government's decision to first implement and then months later overturn their dangerous shark culling policy. The WA decisions drew significant national and international attention. Following the cessation of the WA culling policy, most of the attention and momentum gained by activist groups opposed to bather protection programs that result in the death of sharks and non-target animals was re-directed to the east coast, specifically the NSW SMP.

Activist groups, the media and some local governments continuously sought access to documents, departmental staff, the Minister and the Premier, putting considerable strain on the departmental resources normally available to prepare the APR. Departmental resources were already under strain following the 2010/11 implementation of aerial surveillance and the beach observation tower program. Funds from the SMP budget continued to be re-directed to those programs and away from program management and the observer program, which meant the 'Strategy Leader, Shark Meshing' position remained unfilled. Preparing the APR was one of the core duties of the SMP Strategy Leader. The 2013/14 APR was a collaborative effort by the compliance, science and conservation units of DPI.

The resourcing issue was compounded by a relatively busy SMP year in terms of animals caught and the number of shark interactions over the summer. As described above, the trigger point for the objective of 'minimising the impact on non-target species and threatened species' was tripped in 2013-14 following the entanglement and subsequent death of a Humpback Whale after two were also caught and released alive in 2012-13. Staff from DPI and OEH held numerous meetings throughout 2014 (and they are ongoing) to review the circumstances around those entanglements (outlined above) and to identify what if any mitigative or remedial or operational action would be required to avoid such interactions in future.

The summer of 2013-14 not only included a lot of activity from groups opposed to the SMP, but it simultaneously had some councils and the public outside of the SMP regions questioning whether or not the time had come to introduce similar measures elsewhere in NSW following numerous shark sightings and interactions. In the 2013/14 fiscal year there were seven reported shark incidents in NSW investigated by a DPI Shark Scientist, two of which were fatal, and none of them occurred at meshed beaches of the SMP. The fatalities occurred at unpatrolled beaches at Coffs Harbour and Tathra and involved a surfer and swimmer, respectively. One shark interaction occurred at South Narrabeen beach, which is within the Sydney Central region but is not a meshed beach of the SMP.

2.5.3 Conclusions

Under-resourcing appears to be the single cause of the delayed submission of the 2013/14 APR. The absence of a single program manager for the SMP has meant that other departmental resources are being diverted in a relatively ad hoc fashion to cover the tasks and functions of the Strategy Leader. Under-resourcing was also considered by the FSC to be a significant concern in relation to the observer program, and both problems can only be addressed by a substantial increase in funding.

2.5.4 Recommendations

The review of this reporting incident has not identified a need for any remedial action or changes to the JMA or Management Plan. Clauses 42 and 43 of the Management Plan outline the preparation of budgets for research and monitoring, which may address the issue of observer funding in parallel with aerial surveillance and grants for observation towers, but does not address the issue of program management. The Parties to the Agreements will need to discuss funding arrangements for the management and implementation of the SMP.

3 Outcomes of the 5-Year Review

This section identifies the clauses or aspects of the 2009 JMAs that were identified through the Review Team process as potentially limiting or restricting the capacity of the JMAs to meet their objectives. As discussed in section 1.3, those clauses or aspects were considered to be either editorial, based on submissions from the scientific committees, operational or contractual. Each of those elements will be discussed throughout this section, but for brevity and ease of reference, the potential changes to the JMAs arising from the Review are summarised below in Table 2.

3.1 Editorial

Most of the editorial or structural changes were of a minor nature (e.g. typographical, change dates) and are reflected in the draft 2015 JMA as exhibited. Those minor changes are not listed or referred to herein unless they were a result of the major changes that are discussed below or in sections 3.2 to 3.4.

The major structural changes to the two 2009 JMAs and Management Plan arising from this 5-year review were moving to a single JMA in accordance with the FM Act, instead of two separate JMAs; one in accordance with the FM Act and the other with the TSC Act.

At the commencement of the 2008/09 review of the SMP and development of the draft 2009 JMAs, the TSC Act and FM Act did not contain provisions for a single JMA in accordance with both Acts when dealing with the same subject matter, i.e. threatened species affected by the SMP. The DPI and OEH identified that as a regulatory burden during the 2008 review process, and subsequently made such provisions in the *Fisheries Management and Planning Legislation Amendment (Shark Meshing) Act 2008 No 86*. Those provisions came into force on 18 November 2008.

Technically that meant the two JMAs developed during 2008/09 could have been consolidated into a single JMA, however, that was considered to be inconsistent with the initial stakeholder and departmental consultation that led to development and exhibition of the review and the draft JMAs. The Parties agreed that potentially moving to a single JMA would be more appropriately considered during subsequent reviews, assuming there were no other legislative complications.

This 5-year review has not identified any administrative or legislative impediments, and has therefore moved to a single JMA between the Minister for Primary Industries and the Chief Executive of OEH in accordance with s.221W(3) of the FM Act.

Section 221W(3) of the FM Act states that:

> *A joint management agreement under this Act and a joint management agreement within the meaning of the **Threatened Species Conservation Act 1995** may be combined into a single document if both agreements deal with the same subject-matter.*

The single JMA still applies to the same suite of species and to the two scientific committees as did the two separate JMAs in 2009.

There are numerous editorial changes to the Draft 2015 JMA (and Management Plan) as a result, mostly related to dates, department names, and definitions. The major ones are summarised in Table 2, noting that they apply throughout the JMA not just to the section in which the change first occurred. Most changes to the JMA require the same or similar amendment to the Management Plan, so for the most part are not repeated in Table 2 unless they are markedly different.

Table 2: Summary of recommended amendments to be included in the draft 2015 JMA.

JMA clause number and name	Recommended Amendments	Reference in this Review
1. Legislative Context	References to legislation would be to both the FM Act and the TSC Act	3.1
	References to a single JMA would mean that the term “JMA” means: the Joint Management Agreement for the NSW Shark Meshing (Bather Protection) Program made under section 221W(3) of the *Fisheries Management Act 1994*	3.1
	References to relevant fauna and flora would refer to Marine Mammals, Marine Reptiles, Marine Birds, Fish and Marine Vegetation that are Threatened Species, Population or Ecological Communities or are Protected Fauna or are Protected Fish as defined herein	3.1

Table 2 continued

JMA clause number and name	Recommended Amendments	Reference in this Review
2. Definitions	"Parties to the Agreement" mean the Minister for Primary Industries and the Chief Executive of the Office of Environment and Heritage;	3.1
	"Threatened Species, Populations and Ecological Communities and Threatened Species, Population or Ecological Community" have the same meanings as in the *Fisheries Management Act 1994* and/or the *Threatened Species Conservation Act 1995*.	3.1
	"Protected Fauna" has the same meaning as in the *National Parks and Wildlife Act 1974*.	3.1
	"Protected Fish" means species of fish listed in Part 1 of the Table to clause 5 and Part 1 of the Table to clause 6 of the *Fisheries Management (General) Regulation 2010*.	3.1
	References to the former DECCW and DI&I are now references to OEH and DPI, respectively.	3.1
	"Non-Target Species" means all vertebrate species other other than White Shark (*Carcharodon carcharias*), Tiger Shark (*Galeocerdo cuvier*), Bull Shark (*Carcharhinus leucas*) and the Carcharhinid complex of sharks commonly referred to as whaler sharks and including but not limited to Dusky Whaler (*Carcharhinus obscurus*), Bronze Whaler (*C. brachyurus*), Common Blacktip Shark (*C. limbatus*), Spinner Shark (*C. brevipinna*), and Silky Shark (*C. falciformis*). [Note that Spinner Shark have been added to the list of whaler sharks, and Shortfin Mako Sharks and Broadnose Sevengill Sharks have been removed from the list]	3.2.2
3. Commencement and expiration date	No change	
4. Threatened species and populations to which the agreement applies	Would be amended to read as: This Agreement applies to Marine Mammals, Marine Reptiles, Marine Birds, Fish and Marine Vegetation which are: 4.1.1 Threatened Species, Populations or Ecological Communities; as well as; 4.1.2 Protected Fauna and Protected Fish as so defined in clause 2.1	3.1
Clauses 5 to 7	Minor editorial amendments related to amendments in Clauses 1 and 2 outlined above	
8. Measures by which progress towards achieving the objective is to be assessed & responsibility for their implementation	Clause 8.4.4. and sub-clause 5 of Clause 48 of the draft Management Plan would be amended to include a timeframe of 6 months from publication of the Annual Performance Report for completion of any review reports. Clause 8.4.4 of the JMA would read as: 8.4.4 DPI will, within 6 months of publication of the Annual Performance Report that identified a need for such a report, provide that review report to: a) the Parties to the Agreement, b) the Fisheries Scientific Committee; c) the Scientific Committee; and d) OEH	3.2.1
9. Review of Agreement	The new listing of threatened species would be removed from this clause of the JMA, and added as a trigger point in the Management Plan. Clause 9.1 of the JMA would read as: 9.1 This Agreement is to be reviewed by the Parties to this Agreement five years from the date of commencement.	3.2.2
Clauses 10, 11 and 12	Minor editorial and structural amendments as per Clauses 1 and 2 outlined above	

Table 2 continued

JMA clause number and name	Recommended Amendments	Reference in this Review
13. Relationship to other documents	Amended to include references to the 2009 JMAs, and this 5-year Review report. Clause 13 would read as: 13.1 This document should be read in conjunction with: a) the *5-Year Review of the August 2009 Joint Management Agreements for the NSW Shark Meshing (Bather Protection) Program* (DPI 2015); and b) the *DRAFT 2015 Management Plan for the NSW Shark Meshing (Bather Protection) Program* 13.2 This Agreement prevails in the event of any inconsistencies between this Agreement and the documents referred to in clauses 13.1	

3.2 Submissions

The SC and FSC have reviewed Annual Performance Reports prepared by DPI since 2009/10, and their submissions are appended to those five reports available at the DPI website. Most of their submissions are focussed on but not limited to six key issues: trigger points; removing the month of September from the meshing season; bycatch reduction; and research and monitoring and associated funding. The key issues identified by the committees will be briefly outlined, followed by an analysis of the issues and any potential changes to the JMA recommended by or agreed to by DPI and OEH.

3.2.1 Trigger Points

The committees have consistently indicated that the trigger points: lacked a scientific basis when they were set in 2009; only consider increased catches; are not sensitive to the population parameters of the species; and do not consider the different listing status of the affected species.

The trigger points are an adaptive management and reporting tool, they are not and were not intended to be a scientific monitoring tool or program. They aim to draw the Parties' attention to increased catches of non-target animals, not monitor their populations. Reviews are triggered when catches exceed the trigger points, and the reviews provide the opportunity to assess, amongst other aspects, changes in population dynamics to determine if further mitigative actions are required.

That process would be made unnecessarily complicated if the JMA were to also report on declining catches of threatened species, when reducing the number of such interactions is one of the objectives of the JMA, i.e. being 'effective' could trigger a review. Monitoring, evaluating and reporting on declining catches of those species is more appropriately managed by the relevant agencies, recovery teams and/or the scientific committees for those species. Those groups can advise the Parties of any issues of relevance to the SMP and JMA through the relevant consultative processes.

Nevertheless, there appears to be some merit in re-setting the trigger points for threatened species to better reflect their listed status. The trigger point in the 2009 Management Plan is: *Entanglements of non-target species and Threatened Species over 2 consecutive meshing seasons exceed twice the annual average catch of the preceding 10 years for those species*. The committees have contended that using that trigger point indicates that increased catches in the SMP of for example, thresher sharks, an unprotected species caught by commercial and recreational fishers, are of as much concern as increased catches of endangered sharks, whales or turtles. The trigger points are an adaptive management tool, and ongoing concerns of the committees indicate that this Review should consider adapting them.

In adjusting the trigger points, however, there is a need to retain some flexibility to account for the highly variable nature of the catches in the SMP, otherwise the triggers could be tripped every year. The standard deviation is a statistical measure that is used to quantify the amount of variation of a data set, in this case the year to year catches in the SMP. Standard deviations are commonly used to measure confidence and/or statistical significance, but generally rely on large numbers of data points to retain any statistical certainty or rigour, which is not what is experienced with the very low catch rates of threatened species in the SMP, suggesting they have limited utility in the trigger point process.

Acknowledging the potential limitations of their use, but also mindful of the ongoing concerns of the committees, this Review recommends the use of standard deviations as a surrogate for significance on the basis that in general, effects that fall further than two standard deviations away from what would have been expected (i.e. the average) are considered statistically significant. It is recommended to use this approach for interactions with endangered or critically endangered and for vulnerable species until the next 5-year review, at which point their effectiveness and/or adequacy can be reassessed. The existing trigger point would continue to apply to interactions with other non-target species.

It is therefore recommended to retain the Performance Indicator in the Management Plan but amend the trigger point by splitting it into three parts:

Performance indicator: Change in the number of entanglements with non-target species and threatened species, populations and ecological communities in the SMP,

- Entanglements of Endangered or Critically Endangered species, populations or ecological communities in a single meshing season exceed the annual average catch plus two standard deviations of the preceding 10 years for those species;
- Entanglements of Vulnerable species or ecological communities in a single meshing season exceed the annual average catch plus three standard deviations of the preceding 10 years for those species;
- Entanglements of other non-target species over 2 consecutive meshing seasons exceed twice the annual average catch of the preceding 10 years for those species.

As an example from the 2013/14 meshing season, the existing trigger point approach was tripped for Humpback Whales, a vulnerable species, following entanglements in two successive years, prior to which only one had been caught in seven years. The trigger was hyper-sensitive to those infrequent interactions. The recommended trigger of 10 times the annual average plus three standard deviations would not have been tripped in that instance and better reflects the highly variable and very low number of interactions with that vulnerable species.

On the other hand, the recommended triggers would have been tripped for the 2013/14 interactions for vulnerable Green Turtle and the endangered Leatherback Turtle. Neither were tripped using the existing trigger point despite the interaction with 10 Green Turtles, indicating the trigger was insensitive to highly variable but often relatively higher numbers of interactions.

In addition, clause 9 of the 2009 JMA makes provision for a review of the JMA in the event of new listings, however that is not a trigger point *per se* in clause 12 of the Management Plan and does not formally require a review report in accordance with clause 48 of the Management Plan. In all likelihood any such review would follow the basic outline of clause 48, as occurred following the 2012 listing in the FM Act of Great Hammerhead and Scalloped Hammerhead Sharks. The 2011-12 Annual Performance Report provided a synopsis of the listing implications and concluded that no changes were required to either the JMA or the Management Plan.

To formalise the process and separate the issue from the 5-yearly reviews in clause 9 of the JMA, it is recommended to add a new performance indicator and associated trigger point of the Management Plan objective (clause 12) for threatened species:

Performance indicator: Change in the number or status of species affected by the SMP,

Trigger Point: The listing of a new species, or a change to the status of an already listed species, population or ecological community under the *Fisheries Management Act 1994* or *Threatened Species Conservation Act 1995* that may be directly and detrimentally affected by Shark Meshing.

The August 2009 Management Plan does not specify a timeframe for the submission of review reports related to trigger points or target timeframes, and a six month timeframe was sought by the committees for reports related to new listings (clause 9 of the August 2009 JMA). In light of the committees' comments and the recommended amendments to the JMA and the Management Plan, it is also recommended to include a timeframe of 6 months for all review reports, not just threatened species listings.

The recommended amendments in clause 8.4 of the JMA are as follows:

8.4.4 DPI will, within 6 months of publication of the annual performance report that identified the need for such a report, provide that review report to: the Parties to the Agreement; the Fisheries Scientific Committee; the Scientific Committee; and OEH.

3.2.2 Implications of removing September from the meshing season

This review identified that both scientific committees have consistently recommended effort reductions to further reduce the impact on non-target species, especially Greynurse Sharks and marine mammals. The committees have focussed on removing the month of September from the SMP, but a similar level of impact mitigation to that sought by the committees may also be possible by focussing on particular beaches, or a combination of those and other operational factors.

This issue was discussed in the 2009 review of the SMP. September was retained as part of the meshing season in the JMA due to the potentially heightened risk to bathers should the nets be removed, especially in areas with high catches of White Sharks, notably Stockton in the Hunter region, and to a lesser extent Wattamolla and Garie in Sydney South.

It was also deemed prudent to await the outcomes of the numerous White Shark tagging and ecological studies that were in progress and/or under development at that point in time. Most of those studies are now complete, and as intended by the JMA, this five-year review provides an ideal opportunity to re-evaluate the issue of whether to retain the month of September in the SMP season.

Aim

The aim of this section is to analyse recent and historical catch data in the SMP to assess the potential implications of ceasing to deploy SMP nets in September (hereinafter referred to as reduced effort), both in terms of impact mitigation for the species and for bather protection. A secondary aim was to assess the list of target species on the basis of reported interactions between sharks and people in NSW.

Method

The analysis is primarily of recent SMP catch from 1999/2000 to 2013/14, supplemented by historical data from 1950-1982 as the period of year-round meshing. It includes qualitative descriptions of spatial and temporal catch trends for each species or group, and statistical analysis of the recent catch data for three Threatened-Endangered-Protected (TEP) species (Greynurse Sharks, White Sharks and Dugong); four TEP groups (whales, dolphins, turtles, and hammerheads); and the other sharks and rays reported in recent catch data. The statistical analyses determined whether recent catch levels for each TEP species or group varied significantly by year, month and by beach.

The data were grouped when numbers of related animals were very low, and/or there are species identification issues.

‘Dolphins’ includes Common Dolphin, Bottlenose Dolphin, False Killer Whale, unspecified dolphins, and Indo-Pacific Bottlenose Dolphin.

‘Whales’ includes Minke Whale and Humpback Whale.

‘Turtle’ includes unidentified turtles, Green Turtle, Loggerhead Turtle and Leatherback Turtle.

‘Hammerheads’ includes unspecified hammerhead sharks, Smooth Hammerhead, Scalloped Hammerhead, and Great Hammerhead shark.

For all species, the effect of removing nets on a species was measured as the proportion of captured animals caught in September, and compared to the reduction in effort by removing September (i.e. 12.5% or 1 of 8 months removed). The mean proportion was estimated, allowing for variation between years, and tested for significance against 12.5%.

To assess the potential implications for bather safety and listing as a target species of the SMP, data from the Global Shark Attack File (GSAF - http://www.sharkattackfile.net/index.htm) and DPI investigations of recent interactions were used to determine the number of unprovoked interactions between sharks and people in NSW by species and month since 1900. The data from GSAF (31 July 2015 download) and the DPI investigations are qualitatively described for each species in the Discussion.

Results

Statistical analysis of the past 15 years of catch data indicates that removal of nets for the month of September reduces the proportion of average captured animals significantly more than 12.5% for four species: Greynurse Shark, Broadnose Sevengill Shark, Port Jackson Shark and seals. (Table 3; Figure 6). There was high uncertainty in the estimation of the average percentage catch, as indicated by the size of the 95% Confidence Intervals (Table 3), which resulted from the variation in September catch rates between years (Figure 6).

Table 3: Average percentage catch in September in the SMP, 1999/00 - 2013/14.

	Average % in September	Lower 95% Confidence Interval	Upper 95% Confidence Interval	Significant	Variance Component
Target sharks					
Bull Shark	0				
Shortfin Mako	14.3%	5.0	34.7		0.00
Tiger Shark	5.7%	1.3	22.4		0.00
Broadnose Sevengill Shark	46.9%	30.4	64.1	Y	0.55
White Shark	26.1%	10.9	50.5		1.47
Whaler sharks	10.7%	7.4	15.1		0.16
Non-target animals					
Dugongs	0				
Seals	60.0%	17.5	91.4	Y	0.00
Whales	40.0%	8.6	82.5		0.00
Thresher Shark	9.7%	0.3	78.1		2.85
Greynurse Shark	36.5%	17.8	60.6	Y	0.86
Dolphins	11.8%	1.4	55.5		1.78
Turtles	6.7%	0.3	67.2		1.85
Port Jackson Shark	41.4%	28.5	55.6	Y	0.00
Australian Angelshark	10.5%	6.0	17.7		0.43
Hammerhead sharks	10.9%	6.4	17.7		0.76
Stingray	10.1%	6.6	15.2		0.62

Where: The variance component related to year is also shown. Values above 1 represent strong evidence of year effects.

In absolute numbers, removal of nets for the month of September could potentially (but not significantly) reduce the annual capture of White Sharks by an average of less than three; dolphins by an average of one individual; and on average one turtle every two years and one whale every eight years (Table 4). Hammerheads as a group could be reduced by an average of six per year, noting that the 'group' is comprised of at least 95% of the non-TEP species, Smooth Hammerhead Shark.

Table 4 also indicates that two species, Bull Shark and Dugong, have not been caught in September over the last 15 years, and that September represents:

- less than 25% of entanglements for three other target species and four other non-target species;
- 25-50% of entanglements for seven species or groups, three of which are TEPs and the White Shark which is both a TEP and target species;
- more than 50% of entanglements for one group, seals, of which there only a total of five animals caught over the last 15 years;
- the highest proportion of the catch of target sharks; and
- the second highest proportion of catches of non-target species or groups.

The overall ratio of non-target to target species during the last 15 years was approximately 2.6:1, and ranged from 1.3:1 to 5:1 (Table 4).

Table 4: Total number, average, and percentage of entanglements by month for each species or group in the SMP, 1999/00 - 2013/14.

	Sept			Oct			Nov			Dec			Jan			Feb			Mar			Apr			Total [a]
	No.	Avg.	%[b]	No.	Avg.	%	No.	Avg.	%	No.	Avg.	%	No.	Avg.	%	No.	Avg.	%	No.	Avg.	%	No.	Avg.	%	
Target species/groups																									
Bull Shark																4	0.27	67%	2	0.13	33%				**6**
Shortfin Mako	4	0.27	14%				9	0.6	32%	6	0.4	21%	3	0.2	11%	3	0.2	11%	3	0.2	11%				**28**
Tiger Shark	2	0.13	6%	1	0.07	3%	4	0.27	12%	8	0.53	24%	3	0.2	9%	4	0.27	12%	4	0.27	12%	9	0.6	26%	**35**
Broadnose Sevengill Shark	40	2.67	49%	20	1.33	25%	16	1.07	20%	2	0.13	2%	2	0.13	2%	1	0.07	1%							**81**
White Shark	35	2.33	34%	17	1.13	16%	14	0.93	13%	10	0.67	10%	12	0.8	12%	5	0.33	5%	6	0.4	6%	5	0.33	5%	**104**
Whaler sharks	41	2.73	11%	28	1.87	7%	35	2.33	9%	28	1.87	7%	46	3.07	12%	81	5.4	21%	65	4.33	17%	56	3.73	15%	**380**
Sub-total targets	**122**	**8.13**	**19%**	**66**	**4.4**	**10%**	**78**	**5.2**	**12%**	**54**	**3.6**	**9%**	**66**	**4.4**	**10%**	**98**	**6.53**	**15%**	**80**	**5.33**	**13%**	**70**	**4.67**	**11%**	**634**
Non-target species/groups																									
Dugongs							1	0.07	50%										1	0.07	50%				**2**
Seals	3	0.2	60%										1	0.07	20%				1	0.07	20%				**5**
Whales	2	0.13	40%	2	0.13	40%	1	0.07	20%																**5**
Thresher Shark	10	0.67	29%	4	0.27	11%	9	0.6	26%	4	0.27	11%	6	0.4	17%	2	0.13	6%							**35**
Greynurse Shark	13	0.87	35%	3	0.27	8%	6	0.33	16%	10	0.67	27%	2	0.13	5%				1	0.07	3%	2	0.13	5%	**37**
Dolphins	12	0.8	28%	8	0.53	19%	7	0.47	16%	4	0.27	9%	5	0.33	12%	2	0.13	5%	2	0.13	5%	3	0.2	7%	**43**
Turtles	7	0.47	15%	5	0.33	11%	2	0.13	4%	4	0.27	9%	3	0.2	6%	4	0.27	9%	15	1	32%	7	0.47	15%	**47**
Port Jackson Shark	24	1.6	41%	19	1.27	33%	5	0.33	9%	4	0.27	7%	1	0.07	2%				2	0.13	3%	3	0.2	5%	**58**
Australian Angelshark	21	1.4	11%	13	0.87	7%	23	1.53	12%	29	1.93	15%	29	1.93	15%	25	1.67	13%	23	1.53	12%	28	1.87	15%	**191**
Hammerhead sharks	83	5.53	15%	60	4	11%	69	4.6	13%	64	4.27	12%	59	3.87	11%	70	4.67	13%	78	5.2	14%	56	3.73	10%	**538**
Stingray	76	5.07	11%	62	4.13	9%	121	8.07	18%	157	10.47	23%	97	6.47	14%	26	1.73	4%	65	4.33	10%	74	4.93	11%	**678**
Sub-total non-targets	**251**	**16.7**	**15%**	**176**	**11.7**	**11%**	**244**	**16.3**	**15%**	**276**	**18.4**	**17%**	**202**	**13.5**	**12%**	**129**	**8.6**	**8%**	**188**	**12.5**	**11%**	**173**	**11.5**	**11%**	**1639**
Total	**373**	**25**	**16%**	**242**	**16**	**11%**	**322**	**21**	**14%**	**330**	**22**	**15%**	**268**	**18**	**12%**	**227**	**15**	**10%**	**268**	**18**	**12%**	**243**	**16**	**11%**	**2273**

Where: 'a' denotes that the total does not include catches of finfish (12) or unidentified sharks (4)
'b' denotes that rounding may result in percentages not adding to 100%.

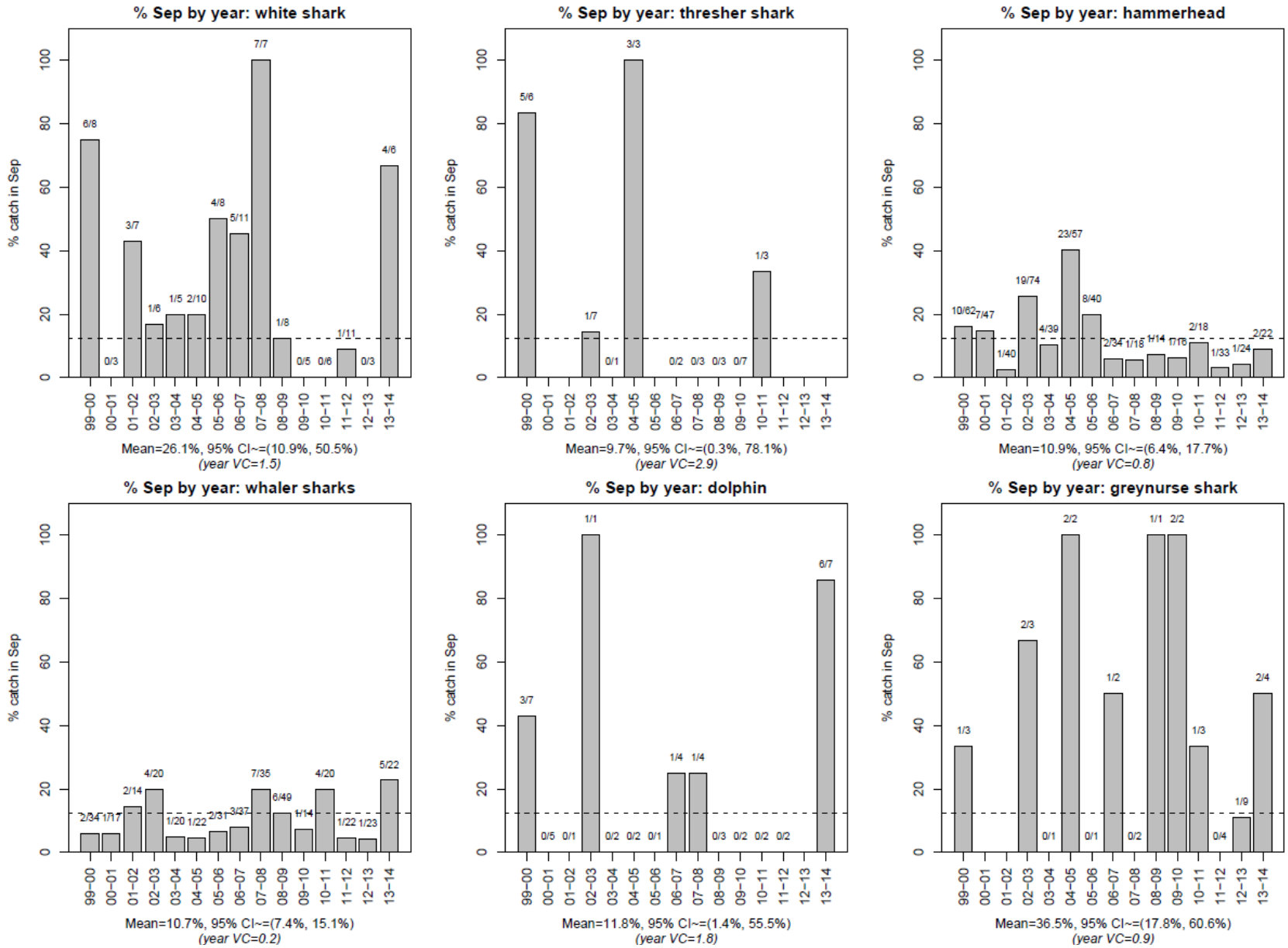

Figure 6: Percentage of the annual catch caught in September for species or groups in the SMP, 1999/00 - 2013/14.

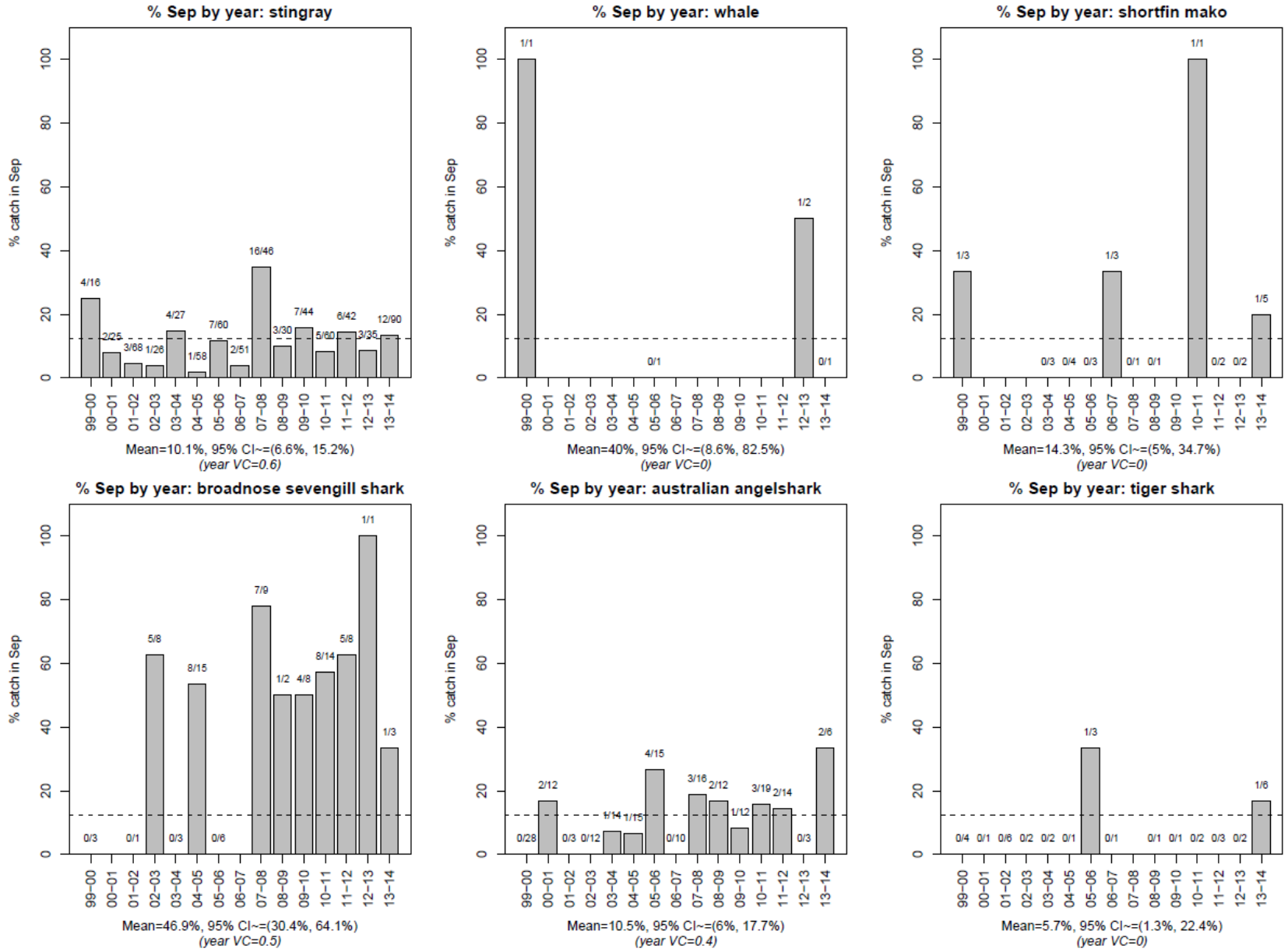

Figure 6 - continued.

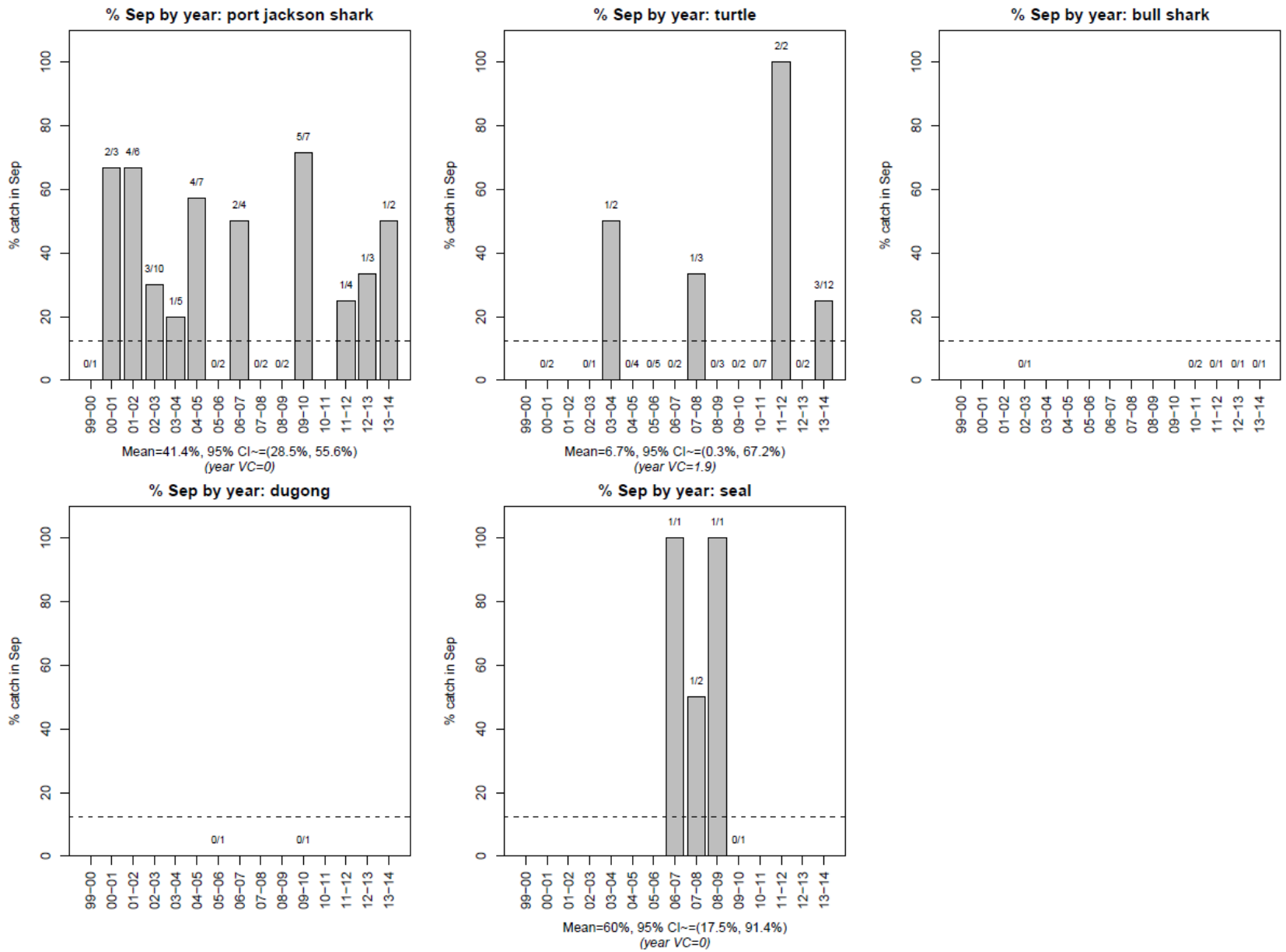

Figure 6 - continued.

There were approximately 255 unprovoked shark interactions reported since 1900, with the Sydney, Northern Rivers and Mid-North Coast regions accounting for more than 70% of interactions (Table 5). The average rate of interactions in the Sydney region in the first 40 years (i.e. prior to meshing) was almost double that of the average rate in the last 75 years, whereas both the Northern Rivers and Mid-North Coast regions have recorded more than half of their interactions in the last 15 years. Those two regions, and to a lesser extent Sydney, have comprised most of the marked increase in the number of interactions in the last 15 years in NSW, which has seen as many reported interactions as in the preceding 70 years.

Table 5: Unprovoked shark interactions by decade and region in NSW, 1 January 1900 to 31 July 2015.

Years	Northern Rivers	Mid-North Coast	Hunter	Central Coast	Sydney	Illawarra	South Coast	Total
1900-09	1	0	1	1	8	0	0	**11**
1910-19	0	1	3	0	11	0	0	**15**
1920-29	0	0	6	0	13	2	1	**22**
1930-39	4	2	3	3	15	1	0	**28**
1940-49	0	3	4	0	8	1	0	**16**
1950-59	2	0	2	2	5	1	0	**12**
1960-69	5	4	2	0	4	2	2	**19**
1970-79	2	1	0	1	1	0	1	**6**
1980-89	5	1	0	1	3	0	0	**10**
1990-99	3	2	0	2	5	0	2	**14**
2000-09	16	17	9	3	15	2	2	**64**
2010-15	12	11	4	2	5	1	3	**38**
Total	**50**	**42**	**34**	**15**	**93**	**10**	**11**	**255**

Source: GSAF download 31 July 2015 (http://www.sharkattackfile.net/index.htm) and DPI unpublished data.

Where: Northern Rivers includes Tweed Heads to and including Pebbly Beach: Mid-North Coast includes Station Creek to and including Smiths Lake; Hunter includes Seal Rocks to and including Flat Rock Point; Central Coast includes Moonee Beach to Pearl Beach; Sydney includes Palm Beach to and including Garie Beach; Illawarra includes Stanwell Park to and including Gerringong; South Coast includes Gerroa to the Victorian border.

Of the approximately 255 unprovoked shark interactions reported in all NSW waters since 1900, almost 80% were reported over the summer and autumn months from December - April (Table 6). Eight interactions were reported for the month of September, seven of which occurred north of Port Macquarie and the other at Jervis Bay. The single fatality reported in September occurred in 2014 at Clarkes Beach, Byron Bay, and was attributed to a White Shark.

Table 6: Unprovoked shark interactions by month in NSW, 1 January 1900 to 31 July 2015.

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Uninjured	11	9	7	5	1	1	1	2	2	3	2	6	**50**
Injured	30	19	14	17	5	4	5	2	5	14	8	21	**144**
Fatal	18	10	8	5	1	3			1		2	12	**61***
Total	**59**	**38**	**29**	**27**	**7**	**8**	**6**	**4**	**8**	**17**	**12**	**39**	**255**

Source: GSAF download 31 July 2015 (http://www.sharkattackfile.net/index.htm) and DPI unpublished data. The asterisk denotes that the month was not specified for one fatality in 1903.

Discussion

The analysis of recent data from the SMP indicates that the average monthly number of entanglements is less than seven for most species or groups, including TEP species. The species or groups with relatively higher rates are all sharks or rays that are harvested by commercial and recreational fisheries and those harvest rates would exceed that of the SMP by at least an order of magnitude. Assuming the worst case scenario and that all animals entangled and released alive do not survive, the SMP still affects only a limited number of TEP animals on an annual basis. Potentially reducing that number further by removing September would therefore appear to be of little or no biological significance to their population status.

The objectives of the JMAs, however, are to minimise the impact of the SMP on TEP species and ensure it does not jeopardise their survival or conservation status. On that basis, any reduction (in this case very small) afforded by removing September could potentially further minimise the impact of the SMP on the affected TEP species and other non-target species. These conservation objectives will be discussed for each target and non-target species or group, in conjunction with an assessment of the potential implications for the bather protection objectives of reduced catches of target species.

Target species of the SMP

Bull Shark: Six identified Bull Sharks were caught over the 15 year period 1999/00 - 2013/14, comprising less than 1% of the total catch during the period, and none were caught in September (Tables 3 and 4; Figure 6). Five were caught in the Sydney regions and one in the Illawarra.

Bull Sharks are now known to undergo large-scale migrations of over 1700km (Carlson et al 2010, Brunsschweiler et al. 2010), and a tagging study from 2011-14 reported that individual mature bull sharks conduct annual return movements in spring-summer between Sydney Harbour and the northern Great Barrier Reef, spending as long as six weeks in Sydney Harbour (Heupel et al. 2015). None of the 75 sharks tagged in NSW during that study were caught in the SMP.

But Bull Sharks also exhibit fidelity to specific areas at specific times (Simpfendorfer et al. 2005, Daly et al. 2014, Heupel et al. 2015) including females exhibiting reproductive philopatry to particular river systems within Australia (Tillet et al. 2012). Recent DPI research has highlighted that Bull Sharks will annually return to specific discreet locations, such as Sydney Harbour, for periods of up to several weeks. The lack of neonates in Sydney Harbour suggested it was not functioning as an area for pupping (Smoothey, NSW DPI, unpublished data).

Many of the shark interactions in the early 1900s and almost all of the fatal ones in Sydney Harbour estuary were attributed to Bull Sharks. However, in the absence of specialist forensic teams like those of today, it is likely that many were misidentified. Recent bite analysis by DPI indicated that at least two incidents in Sydney Harbour were likely attributable to Bull Sharks (1963 and 2009). Bull Sharks have also been responsible for several bite incidents in northern NSW, including the fatality at Ballina in 2008.

Of the 255 unprovoked shark interactions reported since 1900 (Table 5), 26 interactions were attributed to Bull Sharks, the majority (58%) of which were reported in December and January (Table 7). None of the interactions in the month of September have been attributed to Bull Sharks (although one was not attributed to a particular species).

Table 7: Unprovoked interactions attributed to Bull Shark by month and region in NSW, 1 January 1900 to 31 July 2015.

	Northern Rivers	Mid-North Coast	Hunter	Central Coast	Sydney	Illawarra	South Coast	Total
January	1				6	1		**8**
February	1				2			**3**
March								**0**
April	1		1		1			**3**
May		1						**1**
June								**0**
July	1							**1**
August								**0**
September			2					**2**
October								**0**
November		1			6			**7**
December	1				6	1		**8**
Total	**4**	**3**	**3**	**0**	**15**	**1**	**0**	**26**

Source: GSAF download 31 July 2015 (http://www.sharkattackfile.net/index.htm) and DPI unpublished data. The asterisk denotes that month was not specified for one fatality in 1903.

It is acknowledged that there are an increasing number of shark sightings and media and public awareness over the last few summers, particularly of reportedly Bull and White Sharks, and that considering changes to the SMP at such a time could be deemed premature and/or counterproductive to

the SMP. Interactions with Bull Sharks also invariably result in major injuries or fatalities, so despite the very low catch rates they should continue to be a target species of the SMP. However, based on the available data for SMP catch and shark interactions, it appears that the reduced effort would have little or no effect on either the conservation objectives of the JMA or bather safety objectives of the SMP.

Shortfin Mako: Recent catches of Shortfin Mako in the NSW shark nets are highly variable and low, and are spread across the entire SMP season (Table 4). September comprised 14% of the total catch of Shortfin Mako over the past 15 years, and the average September catch of 14.3% was not significantly different from 12.5% (Tables 3 and 4; Figure 6). Most Shortfin Makos were caught in November and December, and early summer is reportedly the time of year when pups are born off the NSW coast (Last and Stevens 2009; Rowling et al. 2010). The size range of Shortfin Makos caught in the SMP is skewed to represent primarily immature animals. Two Shortfin Mako pups (50 and 80cm sharks) were caught over the period, and immature animals (males <195cm and females <280cm) comprise about 85% of the catch.

Mako sharks are often considered a potentially dangerous species, probably based on a combination of their speed, incidents of attacking fishing boats, and their propensity to leap into the air when hooked by fishers, but Makos have never been suspected or implicated in a shark interaction in NSW. Unlike the other Lamnid shark (White Shark) caught in the SMP, Makos are predominantly an oceanic and pelagic species that is occasionally found close inshore, and are probably very infrequent visitors to the surf zone and shallows used by bathers.

This analysis suggests that their status as a target species of the SMP appears inappropriate. The low annual catch and negligible numbers caught in September suggest that the reduced effort would have a limited positive effect on the conservation objectives of the JMA and no impact on the bather safety objectives of the SMP.

Tiger Shark: Recent catches of Tiger Sharks exhibit a seasonal and low catch trend with higher catches in summer and autumn. September and October represent the lowest catches at 6% and 3%, respectively, of the total catch of Tiger Sharks (Table 4; Figure 6). The seasonal trends exhibited in this analysis of catches during the last 15 years are consistent with historical catches from 1950-1983 when meshing was all year round and approximately 80% of the catch of Tiger Sharks was over December-April, with the lowest catches in September (~3%).

The relative increase in September catches in the recent data may be due to the capture of sharks that were present in nearshore waters during the non-netted winter period, which could then reflect in an increased catch at the start of any meshing season (i.e. in October if September is removed). More than half (20) of the Tiger Sharks were caught in the Sydney South region during the 1999/00 - 2013/14 period, and 12 of those were caught at Garie and Wattamolla. Previous analyses of SMP catch have also reported consistently high catches of Tiger Sharks at those two beaches.

Studies of Tiger Sharks at various locations around the world have reported long-distance movements across the open ocean (Holland et al. 1999; Heithaus et al. 2007; Hammerschlag et al. 2012; Werry et al. 2014) and have revealed that individuals regularly return to specific areas, including the site where they were initially tagged, on a regular basis (Lowe et al. 2006; Fitzpatrick et al. 2012, Wirsing et al. 2006, Holmes et al. 2014, Werry et al. 2014).

A recent Australian study included 13 sharks tagged off NSW, for which there were two sharks with long-term data (Holmes et al. 2014). They exhibited large-scale movements between southern NSW and subtropical Queensland waters, generally moving north during winter (July -September), and returning to NSW and exhibiting similar site fidelity as reported elsewhere in the world. Interestingly, the sharks tagged in NSW primarily travelled along the shelf edge, making infrequent visits to nearshore waters. Further, horizontal movements were similarly characterised by transient behaviour. Tiger Sharks exhibited directional swimming of up to several hundred kilometres, coupled with smaller scale (<25 km) resident behaviour, through area-restricted swimming that repeatedly cover the same areas. The study reported that the main areas of activity were the continental slope waters off Seal Rocks and Port Macquarie on the NSW mid-north coast.

Tiger Sharks have been implicated in 11 interactions in NSW waters since 1900 (Table 8). All reported interactions occurred on ocean beaches, three of which were fatal, including that of the surfer at Riecks Point, Coffs Harbour in November 2013. The other two fatalities occurred at Stockton and Bar Beach in February 1948 and January 1949, respectively. The beaches of Newcastle were meshed in December 1949 in response to those and other fatalities and injuries in the region throughout the 1940s. Seasonal analysis of those reported Tiger Shark interactions indicates that only one of those 11 interactions

occurred in September, and did not result in an injury (Table 8). The interaction occurred in 2005 at South West Rocks and the shark reportedly circled a surfer before nudging him off his board and then swimming away. The 11 interactions all occurred between Cronulla Beach and Byron Bay.

Table 8: Unprovoked interactions attributed to Tiger Shark by month and region in NSW, 1 January 1900 to 31 July 2015.

	Northern Rivers	Mid-North Coast	Hunter	Central Coast	Sydney	Illawarra	South Coast	Total
January	2		2		2			**6**
February	1		1					**2**
March			1					**1**
April								**0**
May								**0**
June								**0**
July								**0**
August								**0**
September		1						**1**
October								**0**
November		1						**1**
December								**0**
Total	**3**	**2**	**4**	**0**	**2**	**0**	**0**	**11**

Source: GSAF download 31 July 2015 (http://www.sharkattackfile.net/index.htm) and DPI unpublished data. The asterisk denotes that month was not specified for one fatality in 1903.

Tiger Sharks occur year-round off NSW, albeit in relatively low numbers, and their peak nearshore distribution and abundance appears to be over summer and in the northern half of the coast. They have a wide-ranging diet, and are considered to have indiscriminate feeding habits. World-wide, Tiger Sharks have been implicated in or known to be responsible for numerous shark bites, including recent fatalities in NSW, and should clearly remain a target species of the SMP.

The slight shift to increased catches in September that is apparent since the SMP included a non-meshed period suggests that the removal of the SMP nets during September would probably result in a subsequent increased catch during the 'new' start of the SMP season, i.e. October. Individually or cumulatively, the catches are very low, indicating that catches at that time of year would probably have little or no impact on their population. Coupled with the shark interaction data, they suggest that the reduced effort could have a limited positive effect on the conservation objectives of the JMA and limited impact on the bather safety objectives of the SMP.

Broadnose Sevengill Sharks: Recent catches of Broadnose Sevengill Sharks are all but limited to the first three months of the season and primarily south of the Hawkesbury River, with the Illawarra and Sydney Central regions constituting the two highest catch regions at 58% and 20%, respectively. Recent catches are also strongly skewed to males (81%).

The total catch in the month of September comprised just under 50% of the total catch of Broadnose Sevengill Sharks during the recent period (Table 4), and the average September catch of 46.9% was significantly different from 12.5% (Table 3). Even though the proportions ranged from 0% (four years) to 100% (one year), the relatively narrow confidence intervals for the average reduction in catch (Figure 6) indicate that the average reduction in catch is expected to be much higher than 12.5% (the reduction in effort) if this pattern continues into the future.

These catch trends are consistent with historical catches. Catch data from 1950-83 (i.e. when meshing was all year) shows a four-fold increase in catch from the June-September period to October, before dropping by about half as much again in November. The 'knife-edge' nature of the catch is probably reflective of a fish-down of sharks that have moved into the nearshore waters of NSW during winter and spring (i.e. during the non-meshed period).

The dominance of catch in the southern end of the SMP area is not unexpected given their documented preference for cooler temperate waters and the Sydney area representing close to the northern extent of their known range (Last and Stevens, 2009). Interestingly, none were caught at Wattamolla or Garie

beaches despite being less than 25km north of the Illawarra beaches and accounting for relatively high catches of White Sharks, whalers and Tiger Sharks.

Sevengills are currently a target species of the SMP because of their international reputation as a 'potentially dangerous' species. However, they have not been implicated in any shark bites in Australian waters, let alone NSW, suggesting they should probably be removed from the list of target species.

The knife-edge in the existing catch data at the start of the SMP season suggests that the reduced effort would merely shift most of the catch into October, and the removal of so few sharks is unlikely to have any effect on their population. The removal of September could have, at best, a limited positive effect on the conservation objectives, and no impact on the bather safety objectives of the SMP.

White Shark: Despite the apparent high inter-annual variability in the catch of White Sharks (Figure 7), there were no significant differences between years in catch rates during the past 15 years. Historical catches from 1950-82 show that although White Sharks were caught year-round, there was a seasonal spring peak in October and November with a markedly reduced catch in summer (December - February).

More than a third (34%) of the total catch of White Sharks over the past 15 years occurred in September (Table 4), and there were statistically significant differences between months in catch rate, with higher average catches in the early months of the SMP season. However, the average September catch of 26.1% (Table 3) was not significantly different to the expected catch of 12.5%, suggesting that the removal of September from the SMP season might not necessarily result in an average reduction over 12.5%. The proportions ranged from 0% (four years) to 100% (one year), and the wide confidence intervals for the average reduction in catch (Figure 6) indicate that there is considerable uncertainty about the average percentage of catch in September if this pattern continues into the future.

The data suggest that the currently skewed spike in catch in September is potentially driven by not meshing throughout winter, that is to say the sharks were most likely already in the area before the SMP nets were deployed on 1 September. The reduced effort would probably result in a proportion of the catch being redistributed into October and November when those months represent the start of the meshing season and capture sharks already present in coastal waters.

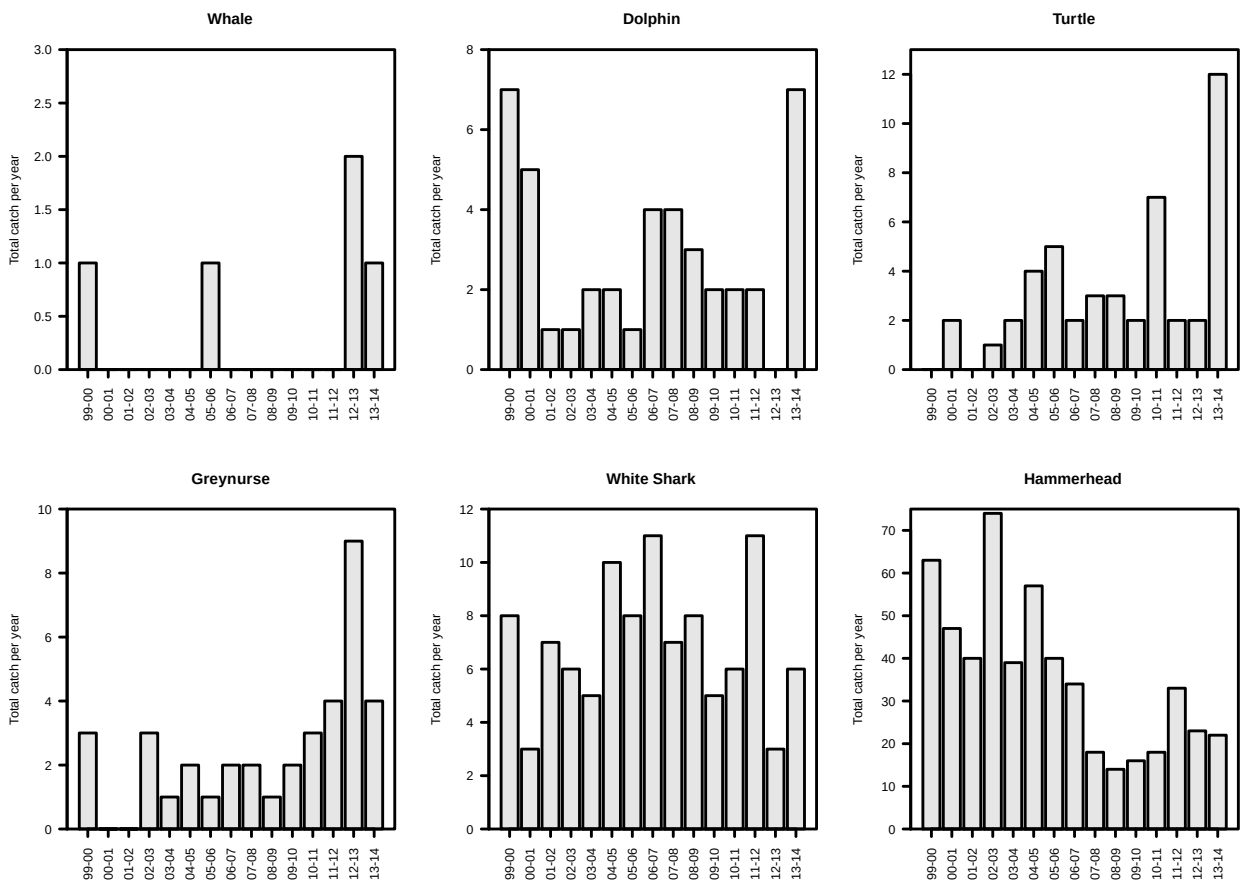

Figure 7: Annual catches of the six TEP species or groups in the SMP, 1999/00 - 2013/14.

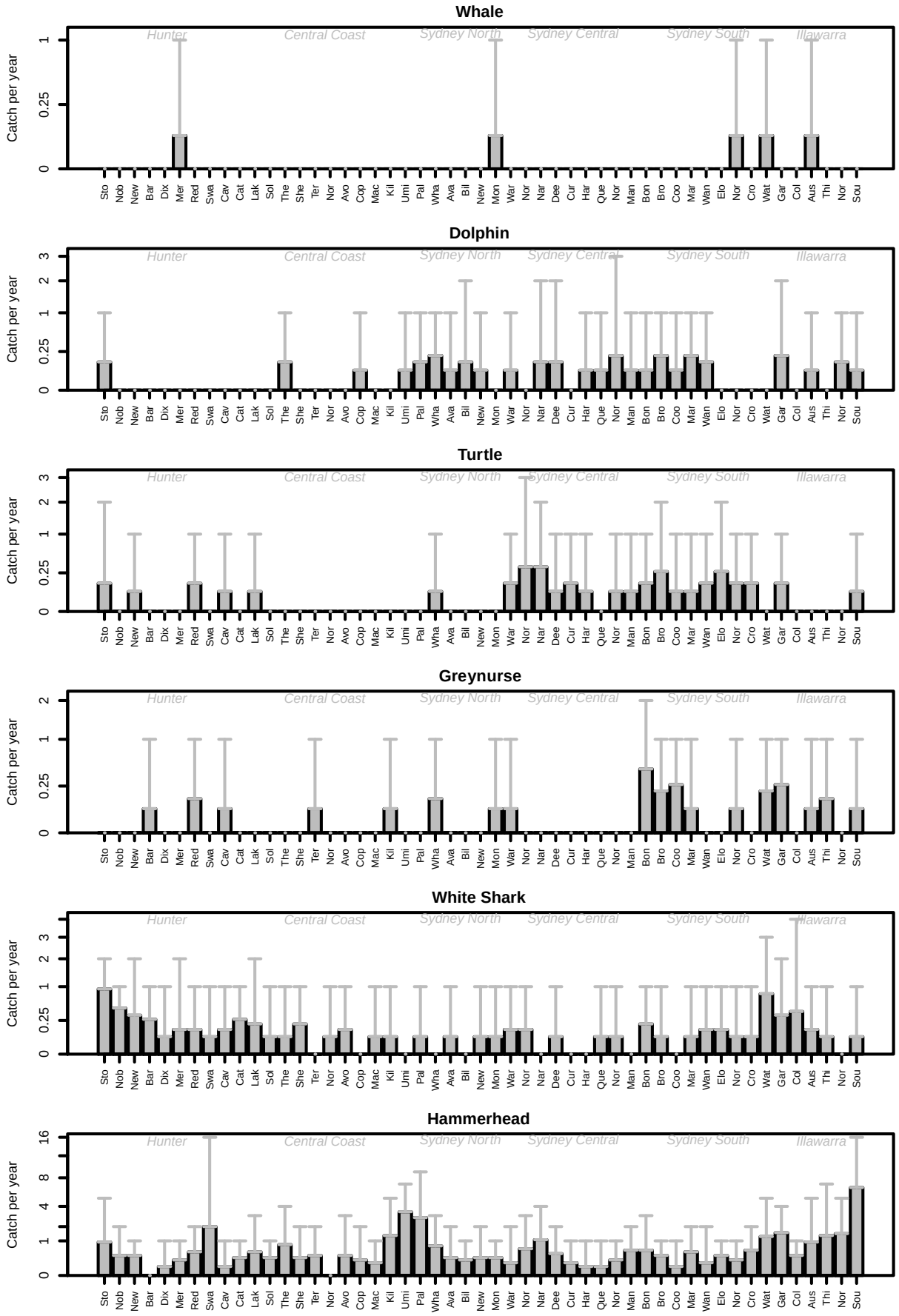

Figure 8: Average catch for each SMP beach for the six TEP species or groups. Upper bar is maximum catch for that beach during 1999/00 - 2013/14.

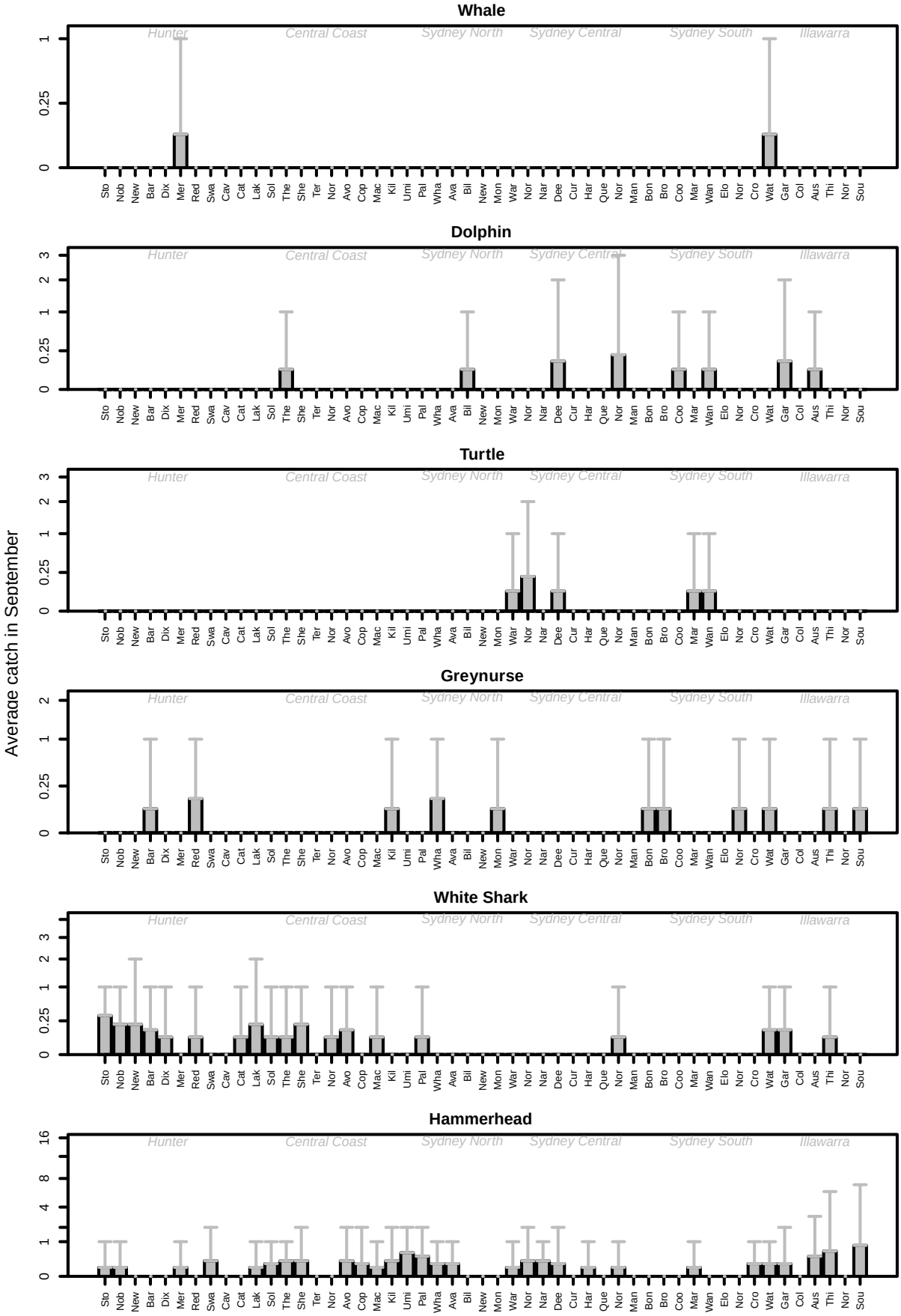

Figure 9: Average catch in September by SMP beach for the six TEP species or groups. Upper bar is maximum catch for that beach during 1999/00 - 2013/14.

Spatial distribution of recent catches were also consistent with historical catches. The Hunter (40%) and Sydney South (27%) regions dominate the overall catch, primarily driven by catches at Stockton (13%) and Wattamolla (12%) beaches (Figure 8). The Hunter and Central Coast beaches also comprise the majority of the average catch in September (Figure 9).

A recent tagging study (Bruce and Bradford, 2012) of 22 juvenile White Sharks (>1.75 - 3m) identified the Port Stephens area as a major aggregation site off eastern Australia and is one of two recognised nursery areas for the east coast population of White Shark, the other located at the Corner Inlet-Ninety Mile Beach region of eastern Victoria. They identified that the Port Stephens nursery area was restricted to a 65km section of the coast centred on the Port Stephens estuary and encompassing three beaches: the northern end of Stockton Beach, Hawks Nest, and Mungo Brush. Travel between the Port Stephens and Corner Inlet nursery areas was directed and relatively rapid, with sharks showing a propensity for travel over depths between the 60m and 120m contours.

Tagged juvenile White Sharks moved up the east coast in winter and spring to areas as far north as central Queensland and then returned south during spring, however they aggregated in the Port Stephens nursery area from spring to early- to mid-summer, and the Corner Inlet region from mid-summer through the autumn. Sharks tagged at Stockton Beach showed significant site fidelity, and sharks that departed and subsequently returned to these NSW beaches did so to this same area, even after journeys of hundreds of kilometres away from the beach.

Although it is currently unknown what environmental drivers delineate the nursery area boundaries, there is considerable ‘spillage’ south into the SMP region, primarily down to the southern end of Stockton Beach but regularly as far as Swansea. For example, the annual Fisheries NSW aerial surveys reported a single White Shark at Stockton in spring 2013, followed by an unprecedented 27 White Sharks between Swansea-Blacksmiths and Redhead beaches during the summer 2013/14 surveys (NSW DPI 2015).

Those reported movement patterns of juvenile White Sharks are consistent with the recent SMP catch data, particularly for Stockton Beach that has only reported catches in the months of September, October and November for the last 15 years.

Table 9: Unprovoked interactions attributed to White Shark by month and region in NSW, 1 January 1900 to 31 July 2015.

	Northern Rivers	Mid-North Coast	Hunter	Central Coast	Sydney	Illawarra	South Coast	Total
January	1	2	1	2	1			**7**
February	2	1	1	1	4	1		**10**
March		1	2	2	4			**9**
April	1						1	**2**
May		1	1	1				**3**
June	1						1	**2**
July	3							**3**
August		1						**1**
September	2							**2**
October	2		2					**4**
November								**0**
December	2	1	1	2	1			**7**
TOTAL	**14**	**7**	**8**	**8**	**10**	**1**	**2**	**50**

Source: GSAF download 31 July 2015 (http://www.sharkattackfile.net/index.htm) and DPI unpublished data.

White Sharks have been implicated in, or known to be responsible for 50 interactions within NSW waters since 1900 (Table 9). Fifteen interactions were fatal, including the three most recent fatalities: a swimmer at Tathra in April 2014; a swimmer at Byron Bay in September 2014; and the surfer at Ballina in February 2015. Nine of the 15 fatalities were at beaches that are now part of the SMP and were the primary driver for its implementation in 1937.

Interactions have occurred in every month except November (Table 9). None had been reported in July until this year, with three in the month between Lennox Head and Evans Head in the Northern Rivers region. The only two interactions that occurred in September also occurred in recent years in the Northern Rivers region; 2010 at Yamba and 2014 at Byron Bay. The majority of interactions attributed to White Sharks occurred over summer, with 33 interactions reported across December to March.

Interactions with White Sharks have occurred from the Tweed to Tathra, but 94% have occurred in the regions north of and including the Sydney region (Table 9). There does not appear to be a relationship between the months and regions, other than the relatively high number of interactions over summer all occurring north of Wollongong.

There has reportedly never been an unprovoked interaction attributed to White Sharks at Stockton, Hawks Nest or Mungo Brush beaches, despite the greater abundance of juvenile White Sharks in the Port Stephens region; the greater proportion of White Shark catch in the nets at Stockton Beach (just south of the nursery area); and that the region represents the highest White Shark encounter rate during the annual Fisheries NSW aerial surveys. Bruce and Bradford (2012) reported that juvenile White Shark hotspots in the northeastern Pacific have not been implicated as high risk areas relative to shark attacks, and suggested that the presence of juvenile White Sharks alone is a poor indicator of attack risk.

Five of the eight White Shark interactions in the Hunter have occurred since 2007, including one at Redhead Beach during the SMP season and another at Redhead Beach four months later outside of the SMP season. Similarly in the Northern Rivers, 11 of the 14 White Shark interactions for the region have occurred since 2007, two of which were fatal. Conversely, the majority (7 of 10) of White Shark interactions in the Sydney region are not recent events and occurred prior to the 1937 implementation of the SMP. The three recent White Shark interactions in Sydney (February and March 2009, and December 2012) have all been at meshed beaches of the SMP and all involved surfers.

White Sharks are the species most frequently implicated in shark bites off the NSW coast, including numerous fatalities and should clearly remain a target species of the SMP. Based on the recent and historical catch data for the SMP, the removal of SMP nets during September could potentially reduce the negative impact on the White Shark population by an average of about three sharks per annum, however that potential reduction in mortalities is more likely to be diminished to some degree by a catch shift into October and November.

As a target species of the SMP and a TEP species that the JMA is supposed to ‘protect’, the White Shark presents the ultimate management conundrum, but few would argue that the bather safety objective would over-ride the conservation objective if a trade-off decision was required. The need for a trade-off becomes even more apparent when, as in this instance, in the absence of a reliable population estimate it is unclear what impact the catches of the SMP are actually having on the population status of White Sharks and therefore on the conservation objective of the JMA.

Assessing the bather protection objective is equally ambiguous. There have been two unprovoked interactions attributed to White Sharks in the month of September since 1900, both of which were on the far north coast, but both occurred in the last five years and one of them was fatal. The majority (71%) of interactions attributed to White Sharks since 1900, however, have occurred between December and March, even though recent tagging studies and historical SMP catch data indicate that this species is present in NSW waters all year round. It is acknowledged, however, that as the White Shark population recovers, it is expected that this year-round residency in NSW waters would increase.

It could be argued that the lower number of unprovoked shark interactions reported during September may be attributed to lower beach use due to cooler temperatures, however, September includes NSW school holidays in the latter half of the month and that may trigger the start of higher bather numbers. In addition, surfers comprise almost half the White Shark interactions and many surfers surf all year round.

Unfortunately, robust monthly estimates of beach visitation and shark interactions across NSW are currently not available and continue to hamper any reliable assessment of the likelihood of a shark-human interaction at NSW beaches. Numerous passive interactions with White Sharks by divers and spear fishers are also not reported to DPI or any shark interaction monitoring organisation (e.g. ISAF), yet the ‘reports’ often appear in social media, and so the data provided in this report are likely to be skewed and underestimate the number of interactions. That is probably true across the year, however, and so is not considered to skew the overall assessment.

The nearshore occurrence of White Sharks in NSW waters during this time of year, however, is well documented through long-term tagging studies and historical SMP data. Additionally, an analysis of SMP data from 1950/51 to 2009/10 indicated an increase in catch-per-unit-effort for White Sharks during the last decade (Reid et al 2011). It was suggested that protection may be assisting population recovery for White Sharks, but also noted that such an interpretation should be treated cautiously given the short time-frame since protection (Reid et al 2011). Erring on the side of caution for bather protection suggests this may subsequently heighten the potential for interactions between people and White Sharks.

It could equally be argued that the waters of central NSW beaches are still cool (i.e. <20°C) during spring, and that the school holidays and associated higher bather numbers do not generally start until the last weeks of September or the first weeks of October, bringing into question the level of bather protection required at that time of year. As noted above, without accurate estimates of beach visitation over that period it is impossible to estimate the relative proportion of the bathing population that is protected by meshing in September.

In addition, there have also been only two interactions in the autumn months of April and May, a time of year when the waters would generally still be above 20°C and theoretically would therefore be more popular for bathers during Easter holidays than in September, hence increasing the potential chances of an interaction. The tagging study of Bruce and Bradford (2012), however, indicated that most of the tagged juvenile White Sharks were in the southern nursery area off Corner Inlet, Victoria, and the far south coast of NSW at that time, not frequenting or inhabiting coastal waters of central NSW, thereby possibly negating any potential increase in bather numbers during Easter (autumn).

Bruce and Bradford (2012) indicated that juvenile White Sharks shift their core range northward into central NSW waters during spring, with the centre of their distribution in the Port Stephens area. The SMP catch data similarly indicate relatively high numbers of White Sharks in September at the northern end of the range of the SMP region (Figure 9), yet without a correspondingly high rate of shark-human interactions in that region, at nearby unmeshed beaches, or elsewhere in NSW waters (Table 5).

The interaction data further indicate that a quarter have occurred in the Northern Rivers region (Table 5), which does not correspond with the distribution data reported by Bruce and Bradford (2012) that shows juvenile White Sharks occurring primarily south of Coffs Harbour during spring and summer. That supports the suggestion of Bruce and Bradford (2012) and overseas studies that the presence of juvenile White Sharks alone is a poor indicator of the chances of an interaction. It also indicates that there needs to be a better understanding of the movements of sub-adult and adult White Sharks in NSW coastal waters.

Relying on the reported interaction rates alone indicates that removing the SMP nets in September is not likely to impact on the bather safety objectives of the SMP, but there is also considerable uncertainty associated with that assessment.

Whaler sharks: This category of requiem sharks of the family Carcharhinidae is thought to comprise at least four species (excluding Bull Sharks): Bronze Whaler (*Carcharhinus brachyurus*); Common Blacktip Shark (*C. limbatus*); Dusky Whaler (*C. obscurus*); and Spinner Shark (*C. brevipinna*). It is therefore unsurprising that there is a relatively high catch spread across the meshing season (Table 4).

Almost twice as many whalers were caught in the latter (summer) half of the season, with only about 11% of recent catches in September, and similarly the average catch in September was only 10.7% (Tables 3 and 4; Figure 6). Those recent temporal trends are consistent with previous studies of historical catches (Krogh 1994; Reid et al. 2011).

Similarly, strong regional differences are apparent in the recent data, with the two southern-most regions, Sydney South and Illawarra representing the two highest whaler shark catch regions at 39% and 19%, respectively. Beaches with high catches were Wattamolla (16%) and Garie (8%), with nearby Austinmer, Coledale, Thirroul and Maroubra each comprising 5% of the whaler shark catch.

Shark interaction data are of limited value for such a diverse and historically poorly identified group of sharks. Collectively ‘whaler sharks’ have been implicated in 43 interactions (Table 10), 12 of which were fatal and eight of those fatalities were in estuaries. Eleven of those 12 fatalities occurred between 1900 and 1960, including the only fatality at a meshed beach of the SMP - 1951 at Merewether Beach. The most recent fatality attributed to a whaler shark occurred at Byron Bay in 1982.

The Sydney (40%) and Northern Rivers (25%) regions account for most of the reported interactions, but unlike the Northern Rivers where interactions are reported from most months, in Sydney they have only been reported from December to April (Table 10). Eleven of the 17 interactions reported for Sydney

occurred in estuaries, whereas only one of the 11 in the Northern Rivers occurred in an estuary. The majority of interactions occurred over summer, with only two interactions reported for September and none in May or June (Table 10).

In the absence of species-specific data, the 'whalers' group should remain on the target list. Whalers are present year-round off NSW, albeit in reduced numbers in winter and early spring, and it is likely that the reduced effort would result in a shift and increased catch of this group during October. In any event, the removal of so few sharks (from potentially four or five species) is unlikely to have any effect on their population. This indicates that removing September could have, at best, a limited positive effect on the conservation objectives of the JMA, and likely a low impact on the bather safety objectives of the SMP.

Table 10: Unprovoked interactions attributed to Whaler Sharks by month and region in NSW, 1 January 1900 to 31 July 2015.

	Northern Rivers	Mid-North Coast	Hunter	Central Coast	Sydney	Illawarra	South Coast	Total
January	1		1	1	5		1	**9**
February	1	1			3	1		**6**
March	2				6		1	**9**
April		1			2			**3**
May								**0**
June								**0**
July	1							**1**
August	1							**1**
September	1	1						**2**
October	1		1					**2**
November	2	2						**4**
December	1	1	3		1			**6**
TOTAL	**11**	**6**	**5**	**1**	**17**	**1**	**2**	**43**

Source: GSAF download 31 July 2015 (http://www.sharkattackfile.net/index.htm) and DPI unpublished data.

Non-target species or groups

Non-target animals will only be briefly discussed because as non-target animals, reducing fishing effort and thereby their capture can only be beneficial to those animals, i.e. enhance the conservation objectives with no impact on the bather protection objectives. As previously noted, however, it is highly unlikely that the limited number of animals affected by the SMP would have any bearing on the population status for any non-target species or group. Discussion will be based on their broad categories of relatively low (less than 25%), moderate (25-49%) or high (greater than 50%) proportion of their catch occurring in September (Table 4).

Relatively low proportion of catch in September

Dugongs

Dugongs are considered occasional visitors to NSW coastal and estuarine waters (Allen et al. 2004).There have been two dugongs (endangered in TSC Act) caught in the last 15 years (Table 4; Figure 6), neither of which was in September, and only five were caught in the preceding 50 years. Single animals have been reported from Coogee, Bronte and Bondi beaches, and two animals from each of Queenscliff and Swansea beaches.

Turtles

The statistical analyses for turtles as a group indicated: significant increases in catch in recent years; significant catches in March; and significantly more caught in Sydney South (43%) and Sydney Central (34%) regions (Table 4; Figures 7-9). Of the other regions, Hunter reported six turtles during the period, Sydney North three, and one each in both the Central Coast and Illawarra.

The 2013/14 season recorded the highest turtles catches, a total of 12 turtles comprised of 10 Green Turtles (vulnerable in TSC Act) and two Leatherback Turtles (both released alive - endangered in TSC

Act), representing 25% of the last 15 year's catch. A Loggerhead Turtle (endangered in TSC Act) was also reportedly entangled off Newcastle beach in 2012/13, but it broke through the net before identification could be confirmed.

There are also some notable differences between the recent and historical catches of turtles. Recent catches have averaged three turtles per meshing year, compared to historical catches of about 1.5 per year. Adjusting the historical NSW SMP catches into an 8 month meshing season to be more comparable with recent catches equates to approximately 1 turtle per year, which is approximately a third of the recent average catch. By comparison, the highest recorded mortalities for Green Turtles off Queensland from reported anthropogenic sources are, on average, 50/year due to boat strike and propeller cuts, and 20/year due to entanglement in crab pot float lines (Limpus et al 2013).

Acknowledging that there are various issues with both historical reporting and attempts to standardise catch per unit of effort, and assuming that changes in catches in the SMP are loosely representative of the broader population, these changes generally suggest that the Green Turtle population off NSW is increasing. The southern stock of Green Turtles that breed within the Great Barrier Reef (of which the NSW 'population' is a small component) has reportedly been steadily increasing across more than four decades at an average of about 3% per year (Limpus et al 2013), which may corroborate the apparent increase of this species in NSW waters. Recent estimates by the Great Barrier Reef Marine Park Authority (GBRMPA) indicate an average annual nesting population of about 8000 females. Similar annual estimates by GBRMPA of the number of nesting females are a few hundred Loggerhead Turtles and several thousand Hawksbill Turtles.

Spatially, the majority of turtles (~85%) were historically caught in the Hunter region, whereas recent catches in the Hunter comprise less than 13%, with catches now predominantly in the Sydney South and Central regions (Figure 8). Temporally, the December to March period comprised about 70% of the historical catches, compared to about 50% of recent catches, and September comprised about 5% of historical catches compared to 15% of recent catches. Even so, there would be no significant decrease in turtle catch with the removal of nets during September.

Hammerhead Sharks

There were statistically significant declines in catch of Hammerhead Sharks during recent years (Figure 7), which is consistent with the historical data, especially since the 1970s. There were also significant differences between beaches, with six beaches comprising almost half the catch: South Wollongong 18%, Umina 9%, Palm Beach 8%, Swansea-Blacksmiths 6%, Garie 4% and North Wollongong 4% (Figure 8). The highest catch during the recent period was in September (15%), but the average catch in September was 10.9% and there were no significant differences in catch rates between months (Tables 3 and 4).

Historical catches from when the SMP was year-round exhibited marked seasonal fluctuation in catch, with peak catches in summer and autumn months, and very low catches in the winter months. The higher catches in summer are thought to be attributable to an inshore movement from deeper waters for parturition between January and March.

Angelsharks and Stingrays

September comprises about 11% of the annual average catch of Australian Angelsharks and stingrays (Table 4), and the average catch in September is just over 10% for both species (Table 3; Figure 6). They are both caught throughout the meshing season, with twice the number of stingrays caught over November and December than in other months. The seasonal peak in catches of stingrays is consistent with historical data, however the historical data also shows a similar seasonality for Angelsharks that is not reflected in the recent catches.

Angelshark catches have shown a long-term steep decline (particularly in the Hunter region) from about 100/year in the 1950s to less than 20/year in recent times. No Angelsharks were caught in Hunter or Central Coast regions from 1999/00 - 2013/14, with the catch apparently shifting southwards to the Sydney South (51%) and Illawarra (26%) regions. To put these SMP catches of ~20 Angelsharks per annum into context, the reported commercial landings of Angelsharks by the NSW Ocean Trawl Fishery have been relatively stable at 30 to 50 tonnes per annum since the late 1990s.

Relatively moderate proportion of catch in September

Whales

Whales comprise a very small proportion of both the historical and recent catches, with zero and five animals, respectively. The five captures during the recent 15 year period (Figure 7) were all caught in the first half of the SMP season and included four Humpback Whales (vulnerable) and a Minke Whale (protected). Two whales were caught in the month of September, but it was not significantly different from 12.5% (Table 3) and the low number of animals was reflected in the wide confidence intervals (8.6 - 82.5% - Figure 6).

The majority of the whale migration season occurs in the winter months off NSW, so occasional interactions in spring are not unexpected. June and July were removed from the SMP season in 1983, and May and August in 1989, in part to mitigate the potential for interactions with migrating whales. The Humpback Whale population that annually migrates through NSW waters is thought to be increasing at about 14%/year, thereby inevitably increasing the ongoing potential for interactions with any fishing gear in the water, including the shark nets. Whilst the interactions with the shark nets are not likely to be having an impact on the population of any species of whale, the removal of nets during September would further reduce potential impacts.

Greynurse Sharks

Greynurse Sharks were caught in moderate numbers during the period (Table 4) and the statistical analyses indicated significant differences for Greynurse Sharks:

- between years, with higher catches in some of the later years (Figure 7);
- between months, with higher catches earlier in the season; and
- between beaches across all months, with high catches in Sydney South (62%).

The total catch in the month of September comprised 35% of the total catch of Greynurse Sharks during the recent period (Table 4), and the average September catch of 36.5% was significantly different from 12.5% (Table 3). Even though the proportions ranged from 0% (four years) to 100% (three years), the relatively narrow confidence intervals for the average reduction in catch (17.8 - 60.6%; Figure 6) indicate that the average reduction in catch is expected to be much higher than 12.5% (the reduction in effort) if this pattern continues into the future.

Recent catches of Greynurse Sharks are predominantly (86%) in the September-December period, whereas historical catches were highest in the January-April period. Recent catches of Greynurse Sharks in September only represent an average of one shark per annum, however this was significantly different to the expected monthly catch distribution.

There are similarly notable spatial differences for Greynurse Shark, with a shift in peak catches from the Hunter region to Sydney South (Figures 8 and 9). The Hunter region historically accounted for about 70% of Greynurse Shark catches, compared to about 11% of recent catches. Historical catches of Greynurse Sharks were also spread across eight of the region's 10 beaches, compared to recent catches that were from only three of the 10 beaches. Sydney South now accounts for approximately 62% of Greynurse Shark catches.

Dolphins

Dolphins as a group were caught in moderate numbers during the period (Table 4) and the statistical analyses indicated significant differences:

- between months, with higher catches earlier in the season; and
- between beaches in September, with some clustering on selected beaches.

The recent results for temporal data for dolphins are reasonably consistent with those reported for the historical, year-round SMP (Krogh and Reid 1996). There are however, some notable spatial differences for dolphins, with a shift in peak catches from the Hunter region to Sydney South (Figures 8 and 9). The Hunter region historically accounted for about 74% of dolphin catches, compared to about 5% of recent catches. Recent catches of dolphins were predominantly in Sydney South (30%), and Sydney North and Sydney Central (23% each).

Port Jackson Sharks and Thresher Sharks

Port Jackson Sharks and Thresher Sharks are caught in moderate numbers, but recent data indicate relatively high proportional catches in September: 41% and 29%, respectively, of recent catches (Table 4). The catches of Port Jackson Sharks are thought to be attributable to an inshore movement from deeper waters for breeding and egg-laying over winter and spring on the NSW central coast (Krogh 1994).

The spatial distribution of Port Jackson Shark catch was pronounced, with 55 of 58 sharks coming from Sydney South, and one from each of the Hunter, Central Coast and Sydney Central regions. More than half (31) of the sharks caught in the period came from Coogee Beach. Similarly, Thresher Sharks were only reported from three regions: Hunter (63%); Sydney South (32%); and Central Coast (5%).

The total catch in the month of September was 41% of the total catch of Port Jackson Sharks during the recent period (Table 4), and the average September catch of 41.4% was significantly different from 12.5% (Table 3). The proportions ranged from 0% (four years) to 71% (one year), and the narrow confidence intervals for the average reduction in catch (28.5 - 55.6%; Figure 6) indicate that the average reduction in catch is expected to be much higher than 12.5% (the reduction in effort) if this pattern continues into the future. It should be noted that 88% of Port Jackson Sharks that were entangled during the last 15 years were successfully released alive (Table 6).

Relatively high proportion of catch in September

Seals

Despite seals comprising a very low proportion of the total catch in the SMP, three of the five seals caught in the last 15 years were caught in September, and the average September catch of 60% was significantly different from 12.5% (Table 3; Figure 6). The wide confidence intervals (17.5 - 91.4%), however, indicate considerable uncertainty about that overall average catch in September, and is reflective of the limited number of animals and years in which they were caught.

All five seals were caught in the Sydney region, with single catches reported from Avalon, North Narrabeen and Maroubra beaches, and two from Wattamolla. Two of the five caught seals were released alive, and the only animal positively identified by Taronga Zoo was an Australian Fur Seal (vulnerable). There were reportedly no seals caught in the SMP prior to 2006. The population of seals inhabiting central NSW waters appears to be increasing, and it is therefore also likely that seal interactions with the shark nets will increase.

Conclusion

The SMP predominantly catches non-target animals, but an increase in the successful release of many non-target species and all species overall indicates that the JMA is reducing some of the potential impact of the SMP. Additionally, the sharks and rays that are caught most frequently are also harvested in other fisheries in NSW and other jurisdictions and are not TEP species.

The TEP species that are affected by the SMP are caught in low numbers, and even though the SMP is recognised as a Key Threatening Process for some of those species, the SMP is a relatively low source of anthropogenic mortality. Reducing that level of mortality by removing September from the SMP may provide some numerical benefit to a few TEP species, e.g. Greynurse Shark, seals and whales, but is unlikely to provide any detectable difference to the population status of any TEP species. Any mitigation, however small, is consistent with the conservation objective of the JMA, which would be enhanced by removing September from the SMP season.

The bather protection objective and level of protection afforded by the inclusion of September within the SMP period of operations remains perhaps the most contentious element of the SMP and groups and individuals have lobbied the Government over many years for its removal. The argument has generally been that the SMP is unnecessary at that time of year due to the limited number of bathers, the lack of shark-human interactions in that month, and the impact on non-target animals.

Despite some informal recording of bather numbers during summer by some lifesaving groups, there is no consistent and systematic data collection process across NSW beaches. It has been identified in the reviews of annual performance reports as an ongoing deficiency of the research and monitoring program of the SMP, and remains an issue that needs to be addressed before the next 5-year review.

The impact on non-target animals is likely to be minimal from a population perspective, but any impact mitigation, especially for threatened species, is consistent with the objectives of the JMA.

It becomes, then, a qualitative assessment of the potential risk to bathers from the target sharks if the month of September was removed from the SMP. The assessment should be a quantitative, statistical analysis including a comparison of interactions at meshed and unmeshed beaches and beach usage both and after implementation of the SMP, as well as a comparison of interaction rates and the corresponding catch rates in the SMP. However, as similarly identified in the reviews of annual performance reports, the data for bather numbers (or population by region since 1900 as a surrogate) and a validated, standardised historical data set are not yet available and should also be addressed before the next review.

The GSAF records show 69 unprovoked shark-human interactions in all NSW waters between 1900 and October 1937, and 35 of those interactions were at ocean beaches and were the driver for the bather protection program that began in October 1937 at 18 Sydney beaches. Thirty-six of those 69 interactions were fatal, 14 of which occurred at ocean beaches that are now part of the SMP. Even though the SMP was initially implemented as a year-round program in response to the 'shark menace', none of those 69 interactions occurred in September. Therefore there is no historical evidence of shark interactions that creates an impediment to removing September.

There were eight reportedly unprovoked interactions in all NSW waters in the month of September since the SMP began in 1937, and that includes 'unspecified shark' and Wobbegongs. Four of the target shark species of the SMP are also those most frequently implicated in those September interactions: White Sharks, whalers, Bull Sharks and Tiger Sharks, and collectively accounted for five interactions in the month of September, with 2, 2, 0 and 1, respectively. With the exception of the Wobbegong interaction at Jervis Bay, the other seven interactions occurred north of South West Rocks on the NSW mid north coast, i.e. some 275km north of the northern-most net of the SMP. For the majority of target species, it appears on the basis of this qualitative assessment of unprovoked interactions that there is no impediment to removing September.

Bull Sharks have not been caught in the SMP in September in the last 15 years, and there have been only two Tiger Sharks caught during that period. The proportion of whalers caught in September during that period is also low (11%) relative to the other months, but close to the expected monthly average of 12.5% (assuming equal monthly distribution of catch), with the majority of catch occurring over summer. Shortfin Makos are also caught in relatively low numbers. The majority of recent catches of Broadnose Sevengill Sharks are in September, however this may be an artefact of the start of the season, as historically they were mostly caught in October and November, and were caught in most months of the year, albeit in low numbers. For those five target species, noting that Broadnose Sevengill Sharks and Shortfin Makos should be considered for removal from the list of target species for the SMP, it appears that based on relative catch in September that there is no impediment to removing September.

In contrast, White Sharks are the only target species that is both caught in the SMP in relatively high proportions in September, and was responsible for the recent interactions at Yamba in September 2010, and the fatality at Byron Bay in September 2014. The relatively high catch in September in the last 15 years is, however, likely to be an artefact of the start of the meshing season, as historical catches when nets were set year-round reported higher catches in October, November and December.

Historical catches and recent tagging studies of juvenile White Sharks also confirm that White Sharks are present in NSW waters all year round, but that they are more abundant in central NSW waters during the spring, with the centre of their distribution in the Port Stephens area. Yet there has never been a reported unprovoked interaction with White Sharks at an ocean beach within the nursery area, nor has there been a corresponding increase in the number of interactions at other beaches during that period of relatively high juvenile White Shark abundance.

Removing September appears to have little impact on bather safety with respect to the majority of target species, however there remains considerable uncertainty about White Sharks and the associated potential risk they pose to bather safety. It may be some years yet before there is a robust and scientifically valid indicator that the east coast population of White Sharks has increased, but the slow increases in catch-per-unit-effort of White Sharks in the SMP during the 1990-2010 period suggest that there has at least been some improvement in the number of White Sharks in the waters of central NSW (Reid et al. 2011). The relatively high number of interactions along the NSW coast in the last 15 years, the recent fatalities at Ballina in February 2015 and Byron Bay in September 2014, as well as interactions with White Sharks at meshed beaches of the SMP indicate that some caution is still warranted in relation to this species.

For the time being, this caution and uncertainty related to the ongoing threat posed by potentially increasing numbers of White Sharks would appear to justify retaining the month of September, especially

given that removing September may reduce numbers of some species caught in the SMP, but is unlikely to have any bearing on the population status of any TEP species.

Whether or not the population of White Sharks is increasing, the human population of coastal areas, particularly the north coast, has increased since the 1990s and thereby increased the likelihood of interactions in those areas. The Government does not currently propose, nor does this Review support expanding the SMP to the north coast, but those recent increases in interactions indicate that some form of bather protection strategy (in addition to existing measures) is required on the north coast.

There is also scope to reconsider this assessment before the next 5-year Review of the JMA, given that the Government recently undertook a process of independent review and trials of non-lethal alternatives to meshing, and a shark tagging project on the north coast.

In addition, this Review (see 3.2.4) also recommends that the scientific research and monitoring program be amended to include the use of population statistics by region since 1900 as a surrogate for bather numbers to be analysed against interactions in NSW waters. That should at least provide some indication of the effectiveness of the SMP that to date has not been possible using the available data on beach attendance. Those two processes should reduce some of the uncertainty and enable a more detailed re-assessment of whether or not the SMP should continue to include September.

This analysis also recommends that Broadnose Sevengill Sharks and Shortfin Makos should be removed from the list of target sharks for the SMP.

3.2.3 Bycatch reduction

The 2009 JMA reduced the maximum length of time between net checking/hauling from 96 hours to 72 hours with the aim of increasing the number of animals that were able to be released alive after being entangled in the SMP nets. That primary mechanism was supplemented by the creation of a 6th meshing region to enable the contractors to achieve those reduced checking frequencies.

It was always acknowledged that the changes would probably not increase survival for marine mammals and reptiles or some of the ram-ventilating sharks, such as makos and hammerheads, but it was thought that reducing the amount of time other animals spent entangled in the nets would enhance the survival of some other sharks and stingrays.

The committees have suggested that 72 hours is not maximising post-release survival rates for non-target species, and have also sought information on whether the mortality rate is related to set time, i.e. higher in nets set more than the prescribed 72 hour soak time, and lower for shorter soak times of 24 or 48 hours. The research plan in the Management Plan also referred to setting nets at a depth of one or more metres off the bottom in order to minimise or eliminate bycatch of rays and benthic non-target sharks.

Reporting over the first five years of the JMA was not at a scale that could accurately determine soak times, although as discussed later in the operational and contractual sections, there are recommendations to move towards finer scale reporting. Similarly, research on raising the nets higher off the bottom has not been introduced across the regions, although the limited data from one region that has trialled raising some nets suggests that it has reduced both the catch of demersal sharks and rays, and reduced the amount of fouling by kelp and other weed (DPI, unpublished data).

The available data for the five years does, however, suggest that the 72 hours has made some improvement in the survival rates of individual species or groups, and a 50% increase overall from 24% released alive in the 10 years prior to the JMA, compared to 37% in the five years since the JMA was implemented (Table 11).

The release rates of White Sharks, which are a target species and a threatened species, have increased by about 50%, and the rate for all other target sharks has trebled. It is important to note when considering the ‘success’ or otherwise of these figures, that it has only been five years, and most species or groups other than target sharks are represented by very few interactions (e.g. less than four marine mammals per year, and less than three thresher sharks per year). It is nevertheless encouraging that there has been some overall improvement, particularly for White Sharks, a vulnerable species and a focal species for managing the SMP through a JMA.

Table 11: Percentage of animals in major faunal groups released alive pre-JMA (1999/00-2008/09) and post-JMA (2009/10-2013/14).

Species or group[a]	Number of animals released alive and total number of animals during the 10 years pre-JMA, 1999/00 to 2008/09										Total released alive pre-JMA	Number of animals released alive and total number of animals in the five years post-JMA, 2009/10 to 2013/14					Total released alive post-JMA
	9900	**0001**	**0102**	**0203**	**0304**	**0405**	**0506**	**0607**	**0708**	**0809**		**0910**	**1011**	**1112**	**1213**	**1314**	
Hammerheads	0 (62)	0 (47)	3 (40)	0 (74)	0 (39)	0 (57)	0 (40)	0 (34)	0 (18)	0 (14)	**0.7%**	0 (16)	1 (18)	0 (34)	0 (24)	0 (22)	**0.9%**
Marine mammals	0 (8)	0 (5)	0 (1)	0 (1)	0 (2)	0 (2)	0 (3)	1 (5)	1(6)	0 (4)	**5%**	0 (4)	0 (2)	0 (2)	2[c] (2)	0 (8)	**11%**
Target sharks[b]	1 (44)	1 (18)	1 (21)	0 (31)	0 (28)	0 (43)	2 (43)	1 (41)	7 (45)	2 (53)	**4%**	2 (23)	7 (39)	4 (36)	4 (29)	3 (40)	**12%**
White Shark	2 (8)	0 (3)	1 (7)	1 (6)	0 (5)	1 (10)	2 (8)	1 (11)	0 (7)	1 (8)	**12%**	0 (5)	0 (6)	5 (11)	0 (3)	1 (6)	**19%**
Thresher Shark	0 (6)	ne	ne	1 (7)	0 (1)	0 (3)	ne	0 (2)	1 (3)	0 (3)	**8%**	1 (7)	1 (3)	ne	ne	ne	**20%**
Australian Angelshark	4 (28)	0 (12)	0 (3)	2 (12)	5 (14)	5 (15)	8 (15)	4 (10)	9 (16)	4 (12)	**30%**	2 (12)	5 (19)	4 (14)	1 (3)	0 (6)	**22%**
Turtles	ne	1 (2)	ne	0 (1)	1 (2)	2 (4)	1 (5)	0 (2)	0 (3)	1 (3)	**27%**	1 (2)	2 (7)	0 (2)	0 (2)	3 (12)	**24%**
Greynurse Shark	2 (3)	ne	ne	1 (3)	0 (1)	0 (2)	0 (1)	1 (2)	0 (2)	1 (1)	**33%**	0 (2)	2 (3)	1 (4)	3 (9)	2 (4)	**36%**
Stingrays	8 (16)	17 (25)	40 (68)	17 (26)	23 (27)	45 (58)	33 (60)	29 (51)	28 (46)	18 (30)	**63%**	33 (44)	40 (61)	33 (42)	27 (35)	65 (90)	**73%**
Port Jackson Shark	1 (1)	3 (3)	6 (6)	10 (10)	3 (5)	7 (7)	2 (2)	4 (4)	0 (2)	1 (2)	**88%**	7 (7)	ne	4 (4)	1 (3)	2 (2)	**88%**
Total	10%	19%	35%	19%	26%	30%	27%	25%	33%	22%	**24%**	38%	38%	34%	35%	40%	**37%**

Where: Number in brackets denotes total number of animals; ne = no entanglements; [a] denotes that faunal groups are consistent with groupings in 3.2.2; [b] denotes that target sharks does not include White Sharks which are listed separately; [c] denotes that two whales swam away still entangled in part of the net.

3.2.4 Research and Monitoring

The Annual Performance Reports prepared since the 2009/10 meshing season indicate that most of the research priorities in Part 6 of the 2009 Management Plan have been addressed, or have commenced and are ongoing. The Level 1 topic (identify information gaps and research needs) was addressed in the 2010/11 report, however as previously discussed, there are some areas of research that have not been addressed due to funding and/or resource constraints.

The annual reports should be used to identify those areas of the Strategic Research and Monitoring Program that require additional funding or modification to ensure their timely and successful completion. The SMP research plan should be a dynamic and flexible document. It should be annually updated in response to the annual performance report and associated submissions from the scientific committees, and should be the basis for annual budgetary assessments. The current situation of a static document and recurring item in the budgetary process does not appear to be fulfilling the requirements of the JMA and Management Plan.

Level 2 research (data collection and review of existing data) and the Level 3 research (establish/support collaborative research) is also largely complete or ongoing, especially with respect to the provision of samples from the SMP supporting collaborative research on White Sharks, Tiger Sharks, Bull Sharks, Wobbegongs, Smooth Hammerhead Sharks, Australian Angelsharks and whaler sharks.

Some aspects, however, are not fully implemented and require additional funding to maximise their potential benefit and contribute to understanding the efficacy and impacts of the SMP. For example,

- funds being re-directed to aerial surveillance trials and the beach observation tower component of the SMP have substantially impacted potential to initiate any new research projects through the resultant lack of budget for research and monitoring;
- there is no standardised procedure or program to accurately determine beach visitation numbers across the state to enable an assessment of the efficacy of the SMP by comparing shark-human interactions at meshed and unmeshed beaches; and
- research to date has been limited to movement and genetic studies of the main target species, and whilst it will provide valuable information for the SMP in the mid to longer term, it is not complimented by similar monitoring of movements of target and non-target species at the nets of the SMP and bathing areas at unmeshed beaches.

The Strategic Research and Monitoring Program in the Management Plan and the program budget need to be updated to address these research and reporting elements that underpin an accurate assessment of the effectiveness of the SMP. As a minimum, it should be amended to include the use of population statistics by region in NSW since about 1900 as a surrogate for bather numbers, and to be analysed against interactions in NSW waters before and after the implementation of the SMP.

The Strategic Research and Monitoring Program also included an assessment of other bather protection strategies, the results of which appear in some of the annual performance reports. It was also initially intended for this Review to include an assessment of any bather protection strategies or technologies that had been developed during the first five years of the JMA, including a summary of those previously described in the annual reports. However, the recent cessation of the Western Australian government's program to mitigate the threat posed by large sharks focussed the attention of the NSW Government and anti-shark-meshing groups on the potential use of non-lethal alternatives for bather protection.

Rather than provide a limited synopsis of alternative strategies or technologies in this Review of the JMAs, this Review will defer to the outcomes of the NSW Government's comprehensive assessment process. The three-step process will include an independent review of the various non-lethal alternatives to shark meshing and other emerging technologies; stakeholder workshops to identify those technologies most likely to be effective at the ocean beaches of NSW; and to conduct comparative trials of those technologies at NSW ocean beaches.

This Review reiterates the submissions of the scientific committees with respect to the potential for scientific outcomes being partly compromised by limited funding. This review recommends that the Strategic Research and Monitoring Program in the Management Plan, and the program budget be updated to more accurately reflect the level of funding required to fill research gaps that will underpin an accurate assessment of the effectiveness of the SMP.

Bather protection is an issue across all NSW beaches, not just within the area of the SMP, as was highlighted this year with numerous interactions on the far north coast, including a fatality and some serious injuries. Potentially expanding the meshing program to other parts of the coast would likely pose significant social, economic and environmental costs. The Government's review of non-lethal alternatives provides an ideal opportunity to reassess the funding model for the SMP, and to more holistically appraise the bather protection strategies and funding to apply to ocean beaches outside of the Newcastle to Wollongong greater metropolitan.

3.3 Operational

An ongoing concern is that observer coverage has been reduced every year due to funds being re-directed to aerial surveillance trials and the beach observation tower component of the SMP. There is currently no single point of management for the program, with management absorbed by a combination of staff from the science, compliance and conservation units of DPI.

The Review Team identified that some of the aforementioned issues and research gaps could be partly addressed through operational changes to the SMP, similar to improvements made in 2009 through the original JMAs. The number of regions and the use of vessel monitoring systems were identified as having potential to not only partly address numerous issues, but also to provide flow-on benefits for other parts of the SMP, such as reduced compliance costs and more timely and accurate reporting.

3.3.1 SMP regions

The JMAs and Management Plan currently include six regions between Newcastle and South Wollongong, noting that there are unmeshed beaches in each region: Hunter (Stockton Beach to Catherine Hill Bay Beach); Central Coast (Lakes Beach to Umina Beach); Sydney North (Palm Beach to Warriewood Beach); Sydney Central (North Narrabeen Beach to Manly Beach); Sydney South (Bondi Beach to Garie Beach); and Illawarra (Coledale Beach to South Wollongong Beach).

There are separate meshing contracts and contractors for each Region, and they vary in the numbers of nets and the distances required to service those nets. In particular, Central Coast is the most extensive and intensive, some 51kms long with 11 nets. The Hunter and Sydney South regions both have 10 nets and are approximately 37kms and 39kms, respectively. The other three Regions are all less than 20kms in distance and have between 5 and 8 nets.

The JMAs split the then Sydney North region into two, the Sydney North and Sydney Central regions, which were both about 14kms long and had 7 and 8 nets, respectively. The original region was split to enable increased compliance with the contracts under the JMA, as it was understood at the time that the the size and number of nets in Sydney North was impractical for contractors.

The review of the 2013/14 and 2014/15 meshing seasons suggests that there is now a similar capacity issue on the Central Coast. Whilst most of the non-compliance issues were of a minor nature and were addressed during the season, overall the Central Coast region was deficient in terms of the required number of meshings for every month in 2014/15. The Hunter region also experienced difficulties in 2014/15, but the shortfalls in the number of meshings were made up during subsequent months as provided for in the Management Plan and contracts. During discussions with Contractors as part of this Review process, it also became apparent that the beach allocations in the southern regions was also problematic due to the number of beaches, the distances between them and their location relative to the ports used by Contractors.

To further improve the manageability of the regions and contractual compliance for the Contractors, and thereby improve the outcomes of the JMA, it is recommended that the 21 beaches of the Hunter and Central Coast regions will be rearranged into three regions:

- Hunter region, comprised of Stockton, Nobbys, Newcastle, Bar, Dixon Park, Merewether, and Redhead beaches;
- Central Coast North region, comprised of Blacksmiths, Caves, Catherine Hill Bay, Lakes, Soldiers, The Entrance, and Shelly beaches; and
- Central Coast South region, comprised of Terrigal, Avoca, North Avoca, Copacabana, Macmasters, Killcare, and Umina beaches.

In addition, Wattamolla and Garie beaches should be reallocated into the Illawarra region. That would leave Sydney South with the eight meshed beaches between Bondi and Cronulla, and Illawarra with the

seven meshed beaches between Wattamolla and South Wollongong. It is acknowledged that the Illawarra region would increase in distance, but it also increases the number of nets making that contract more economically viable and more attractive to prospective tenderers.

There are no changes recommended for either Sydney North (seven beaches) or Sydney Central (eight beaches) regions. Overall, the recommended configuration would establish seven regions, each with seven or eight beaches to mesh and with comparable distances between nets and ports.

3.3.2 Vessel Monitoring

The existing contracts make provision for Contractors to install and use Vessel Monitoring Systems (VMS) and Integrated Voice Response (IVR) systems on their vessels if directed by the Principal's delegate. The VMS are multi-functional programs that, depending on the complexity of the system, can provide real-time automated location reporting, constant video, and/or catch recording. The IVR systems require the operator to make a number of telephone calls and to either leave voice recorded information or input standardised criteria through the phone keypad.

The only form of geographic reporting similar to VMS that has been used in the SMP is a smartphone application called "Navionics", which charts the track of the smartphone and overlays the track onto a map. The "Navionics" application was used for all observer trips in the 2014/15 season, and similar applications are available for most mobile devices, including a program designed and maintained by OEH. Contractors, however, generally rely upon the course plotters in their vessel management systems to record information rather than use electronic mobile devices out at sea. Plotters are vessel-specific technology, and the quality and type of information that can be stored in or obtained from those systems is therefore both inconsistent and of limited use to either Contractors or compliance staff.

Vessel monitoring through either VMS or IVR has numerous potential benefits for the SMP, including but not limited to: reduced compliance costs for DPI; less requirement and cost for observers; ease of reporting for Contractors; increased voluntary compliance; more accurate reporting and assessment of net soak times and associated net fouling, loss and animal mortality rates; and assisting with responses to enquiries from the media and public.

This review considers the relative infallibility, simplicity, and the breadth and depth of information that can be derived from VMS to be more appropriate for the SMP than IVR or any similar mobile device system. This review recommends that references to the potential use of IVR be removed from the contracts, and that a standardised VMS be implemented across the vessels of the SMP.

3.4 Contractual

Most of the potential changes to the contracts of the SMP would arise from acceptance of any of the recommendations throughout this Review. In addition, the six existing Contractors were given the opportunity to identify any elements of the existing contracts and/or operational elements that they considered to be inefficient, ineffective or similarly limiting the implementation of the JMA and Management Plan for the SMP. There was often disagreement between Contractors about the issues, and the following synopsis does not necessarily represent the views of all Contractors.

Many of the issues they identified, such as 28-day reporting, invoicing, the need for verbal not written agreements with respect to fulfilling the number of meshing days, vessel suitability, and tendering process, are long-standing issues of a primarily legal nature that were beyond the scope of this Review.

Some of the issues were inconsistent with and would require overturning many of the provisions and amendments introduced through the JMA and could not be supported by the Government. They included requests for double-netting, additional beaches, additional months, and at least 96 hour net checking.

Some of the issues were actually part of the existing contract or Management Plan, e.g. request to use 8 inch floats (contract) instead of 12 inch floats (as Contractor perceived) to mark the nets, and interfering with SMP nets should be an offence under the FM Act (it is).

The majority of Contractors considered that the provisions in the Management Plan and contract for 72-hour net checking (clause 23(1)d) and to remove nets from the water at completion of the allocated meshings per month (clause 23(1)h) were contradictory and inconsistent with the objectives of the SMP. The terms used in the Management Plan were also considered to be confusing and/or potentially confounding, especially in light of the 72-hour checking provision. There was considerable debate as to what constituted meshing, hauling, setting, checking, and running the nets. The basic premise according to Contractors was that nets were to be set on 1 September, checked every 72 hours (or earlier), and

retrieved on 30 April. All but one of the Contractors had always operated that way, and asserted that inclement weather every year still made it difficult to meet their contractual and JMA obligation for “12 meshings per month plus every weekend of the meshing season”.

The Review Team concurred with Contractors in so far as the Definitions, Clause 22 and Clause 23 of the Management Plan and their related clauses in the contracts provide significant scope for interpretation. The review recommends rationalising the definitions, and removing references to removing nets from the water after the allocated meshings per month.

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